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Effects of Feedback Loop Model on Teachers' Attitudes, Self-Efficacy and Classroom Practices towards Formative Assessment

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Abstract

This research endeavor that aimed to determine the changes in the Senior High School (SHS) teachers' attitudes, self-efficacy, and classroom practices toward formative assessment (FA) as they implemented Feedback Loop Model (FLM) in their Physics classes was examined to assess any improvement in their attitudes, self-efficacy and teachers' FA practices. Using a concurrent triangulation design to address the objectives of this study, a convenient sampling method was employed. Out of the 23 teacher-participants who attended the webinar series on FLM, only 3 Physics teachers agreed and participated in the follow-up process, which requires implementing FLM in their classrooms. These teachers approved recording their online classes, which were used for observation by external observers or cross-examiners. Likewise, they agreed to keep journals or reflections as they implemented the FLM in their Physics classes. Results have shown that teachers' attitudes, self-efficacy, and classroom practices on FA were affected significantly, leading to positive attitudes toward utilizing the assessment and improved self-confidence in applying FA in their classes. Teachers were also able to manifest and build a classroom environment that supports formative assessment, signifying the positive effect of the FLM. Therefore, it is suggested that FLM be recommended to strengthen the use of FA by conducting more professional development programs. This way, teachers would have opportunities to refine their strategies and enhance collaboration and professional growth.

Introduction

Teachers play an integral part in any change in educational reform (Genc, 2005), and it was emphasized by Wiliam (2011) that the heart of formative assessment is based on a *teacher's decisions*. Given the underlying benefits of formative assessments when used effectively (Ash & Levitt, 2003), a teacher's ability to implement a successful formative assessment depends on how well it is executed in the classroom. Although it has been pointed out that the use of formative assessment practices has a positive impact on student achievement, Dunn & Mulvenon (2009) and Bennet (2011) questioned the conclusions based on conceptual matters and methodologies that constrained the scientific evidence gathered from the impact of promoting formative assessment. As Heritage et al. (2009) explained, teachers find it challenging to apply assessment information when planning subsequent instructions.

In the Philippines, the educational context of teachers' practices of FA shows inconsistency between theory and practice. In the study conducted by Cagasan et al. (2020), teachers' high claim of understanding and applying FA in their classes is somewhat inconsistent with their actual classroom practices. Only a few indications of FA practices were observed (Griffin et al., 2016) because teachers' teaching sequences showed little flexibility in adapting lessons corresponding to student progress to which FA practices are expected.

With the current state of FA practices, teachers need to expand their understanding of using assessment formatively to promote student learning. Using the data-driven approaches to classroom assessments called the Feedback Loop of Furtak et al. (2016), this framework depicted in Figure 1 is designed to help science teachers efficiently and systematically sort through the data, extract meaningful information, and determine teaching and student learning steps. This Feedback Loop Model (FLM) uses formative assessment data, which focuses on what teachers can do when working together to set learning goals, design tools iteratively, collect data and make inferences based on that data to guide their instruction. It advises them on how they will implement the intended framework of FLM for better science teaching and meaningful learning for students in their Physics classes.

Figure 1. Feedback Loop Model (Furtak et al., 2016)

More importantly, teachers' beliefs and understanding of learners play an essential role in restructuring assessment in science. The success of implementing a new approach must start at the classroom level, with teachers initially experiencing significant changes in their beliefs and practices (Genc, 2005). Thus, this can be augmented by conducting professional development programs (PDPs) for teachers as an essential aspect of professional growth in equipping and training them to be competent and qualified in the delivery of the K-12 curriculum, especially in addressing the impacts brought by the global crisis as anchored on the DepEd Order No. 024, s. 2022 or adopting the basic education development plan (BEDP) 2030. Furthermore, as supported by a policy in assessment (DepEd Order No. 8, s. 2015) that strongly encourages teachers to focus on formative assessment (FA), this study aimed to strengthen teachers' FA practices. This research endeavor also echoes the universally applicable global 'targets' of the 2030 sustainable development goals (SDGs) that aim to substantially increase the supply of qualified teachers, especially in the least developed countries.

Objectives of the Study

This study aimed to determine the changes in the Senior High School (SHS) teachers' attitudes, self-efficacy, and classroom practices toward FA as they implemented FLM in their Physics classes.

Specifically, it sought to address the following questions,

1. What are the teachers' initial attitudes, self-efficacy beliefs, and classroom practices toward formative assessment?
2. What are the changes in teachers' attitudes, self-efficacy beliefs, and classroom practices toward formative assessment after implementing the FLM?

Method

Research Design and Environment

With the use of a concurrent triangulation design, this mixed-method type of research enabled the researchers to address the objectives of this study. The quantitative information obtained from the adopted instruments, which measured teachers' attitudes, self-efficacy beliefs, and classroom practices towards FA, were analyzed and triangulated to the different forms of qualitative data such as journals, reflections, and classroom observations.
Also, this study focused on the private schools that offer Online Distance Learning (ODL) modality in the province of Negros Occidental, Philippines. Inclusion criteria for these private schools must include academic tracks that offer Physics in their curricula and adopt synchronous classes. Due to the pandemic threat, all procedures in this study have transpired in the virtual context, from the conduct of the PDP up to its data collection.

Research Participants

Initially, 28 teachers registered in the webinar series; however, on the first day of the webinar, these were reduced to 23 teacher participants. Since the invitation was sent a month before the scheduled dates and July was a summer break, conflict of schedules and change of mind may have caused this reduction.

Hence, 23 Senior High School (SHS) teachers from the province of Negros Occidental participated in the Feedback Loop Model Professional Development Program (FLMPDP). Most came from the capital city, which consisted of 19 (82%). Others came from the nearby city, which consisted of 2 (9%) teachers, while the rest of them, 2 (9%), originated from the northernmost city of the province. A majority (91%) of the Physics teachers who participated had less than five years of teaching experience in teaching Physics and with areas of specialization in Physical Science (39%) and Science (39%). The age range of 20 – 25 indicates that most SHS teachers are young professionals categorized as novice teachers.

During the training program, the researcher selected potential teachers who would be put through the implementation and evaluation of the FLM in their classes. After identifying these potential teachers, they were sent an email and were informed of the follow-up process. The inclusion criteria for the selection were based on their complete attendance for the 4-day webinar series, the teacher handling a Physics course during the first semester, and most importantly, their willingness to participate in the study. Out of the number of teachers who were sent an invite, only 6 teachers replied and gave positive feedback to the invitation. However, as the class observation drew closer, 3 teachers withdrew their participation because of ethical considerations.

Therefore, in this study, only 3 teachers agreed to be evaluated for the effect of FLMPDP. These teachers approved recording their online classes, which were used for observation by external observers or cross-examiners. Likewise, they agreed to keep journals or reflections as they implemented the FLM in their Physics classes. They were also provided with a consent form indicating the intent and purpose of the study and the confidentiality of their identities. All gathered information was assured to be kept as confidential as possible, and if they decided to discontinue, they were allowed to withdraw at any time without prejudice.

The 3 SHS Physics teachers who graciously accepted the invitation and submitted their recorded online classes were examined by cross-examiners (CE) or experts. They notably observed how teachers utilized the FLM in their Physics classes. The purpose of using cross-examiners or experts was to facilitate deeper understanding and shed light on how teachers practice FA in their classes without bias. They were chosen based on their familiarity with the FLM. The first cross-examiner was a Ph.D. candidate in Science Education who had a background in the different elements of FLM, which were discussed during their Assessment course. The second cross-examiner was a Learning Area Coordinator for Science in a prestigious private school who attended the webinar series of the FLM. Her experiences in administration tasks could be utilized to objectively articulate and assess the teacher-participants. The third expert was an Assistant Professor in a SUC who served as one of the speakers in the FLMPDP. Given the credentials of these cross-examiners, their observations can be used to identify any changes in teachers' classroom practices towards FA.

Research Instrument

Data collection was retrieved using Google forms before and after the webinar series. With the instruments called *Teachers' Conceptions and Practices of Formative Assessment Questionnaire* by Yan and Cheng (2015) that measured teachers' affective and instrumental attitudes and self-efficacy toward FA and *Teachers' Practices on Formative Assessment Scale: A measure using Feedback Loop* by Ole (2020) that focused on the FA classroom practices based on FLM, relevant information needed in the study were systematically analyzed and interpreted accordingly.

Moreover, this study utilized another essential tool used by cross-examiners or experts. This adopted tool evaluated the teachers' classes as they implemented FA using FLM. In this instrument called School-wide Walk-through Tool – Assessing a School's Progress Along a Continuum of Formative Assessment Practice, the Council of Chief State School Officers (CCSSO) Formative Assessment Attribute identified five (5) essential characteristics that needed to be observed in the classes while conducting the FA based on FLM.

Overall, the concepts of FLM elements and the CCSSO FA attributes are overlapping aspects that could assess teachers' classroom practices towards FA. The *learning goals and success* implied its connection with *setting the goals* of FLM. At the same time, the *Descriptive Feedback* and *Self- and peer assessment* integrated the *tools, data, and inference* elements based on the characteristics shared by the CCSSO FA attributes. Meanwhile, the criteria describing the *collaboration* attribute characterized the *data* collection of FLM and, likewise, the teacher in *making inferences* to give feedback. Lastly, the *learning progressions* denoted how *making inferences* could lead to achieving the learning *goals*.

A framework called **Relationship of CCSSO FAA to Elements of FLM** that represented the current study depicted the connections and overlapping concepts of utilizing formative assessment practices in the context of the synchronous class setting based on the criteria presented within each variable. Using the framework in Figure 2, the relationship of attributes of FA, classroom environment, and elements of FLM could be used as an essential guide when assessing and evaluating teachers' classroom practices based on the Feedback Loop Model (FLM).

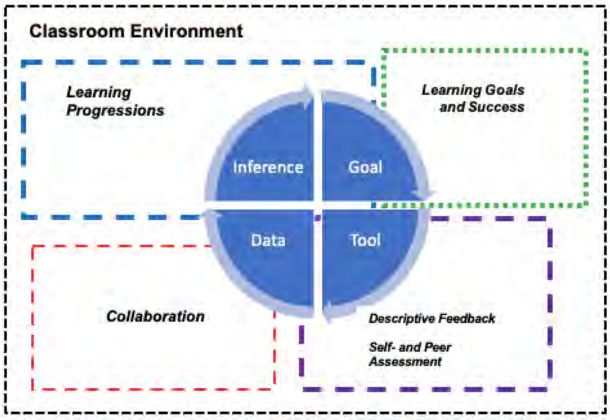

Figure 2. Relationship of CCSSO FAA to Elements of FLM

Research Procedures

The 4-day webinar series using an online platform was conducted every Saturday for the entire month of July, specifically on July 10, 17, 24, and 31, 2021. The speakers for the webinar series consisted of science teachers with more than ten years of teaching experience and were considered experts in the field of Physics teaching. Every Saturday of the month, a new speaker was assigned to discuss the four elements of the Feedback Loop. These speakers were oriented and given electronic copies of the developed training guide and Furtak et al. (2016) book for reference. At the end of the series, the 3 teachers who accepted the challenge to be followed up were oriented about the expectations of the implementation process in their respective classes. Sources of data that could be used to evaluate the effect of the FLM included classroom observations that were cross-examined by external validators and teachers' journals or reflections.

Ethical Consideration

This study highly considered confidentiality and, therefore, employed various ethical considerations. Before conducting this study, proper authorities from each private school were sent with letters duly approved and endorsed by the researcher's consultant/mentor and coordinator for graduate programs. All teachers participating in the implementation process of FLM were treated with respect and assured anonymity. Records acquired from this study were treated with confidentiality, and their identities were not disclosed. Codes were provided to all recordings, transcripts, and documentation, and all gathered information was kept in locked files at all times.

Results and Discussion

This section details the pre- and post-survey results of the three SHS Physics teachers' affective and instrumental attitudes, self-efficacy beliefs, and classroom practices toward formative assessment. Any changes after implementing the PDP were examined and supported using other data acquired through journals, reflections, and classroom observation tools assessed by cross-examiners. The effects of the FLMPDP in their Physics classes were analyzed to understand better teachers' attitudes, self-efficacy, and classroom practices in conducting the FA based on FLM.

Affective Attitude (AAT). According to Yan and Cheng (2015), this type of attitude examines teachers' feelings or emotions motivated by the formative assessment. Based on Figure 3, it can be observed how the teachers shifted their degree of agreement before and after the training program.

Initial findings suggest the diverse agreements of the teachers on the items under AAT. Out of the seven questions *strongly agreed* upon by Teacher 1, this particular item or statement which expresses *Formative Assessment encourages students to help each other (Q5)* has only received an agreement from the teacher. However, the other two teachers agreed slightly on this description. For Teacher 2, it can be noted in Figure 3 that most of the items registered *slight agreements,* while Teacher 3 has equal distributions of strongly agreed and agreed on the claims.

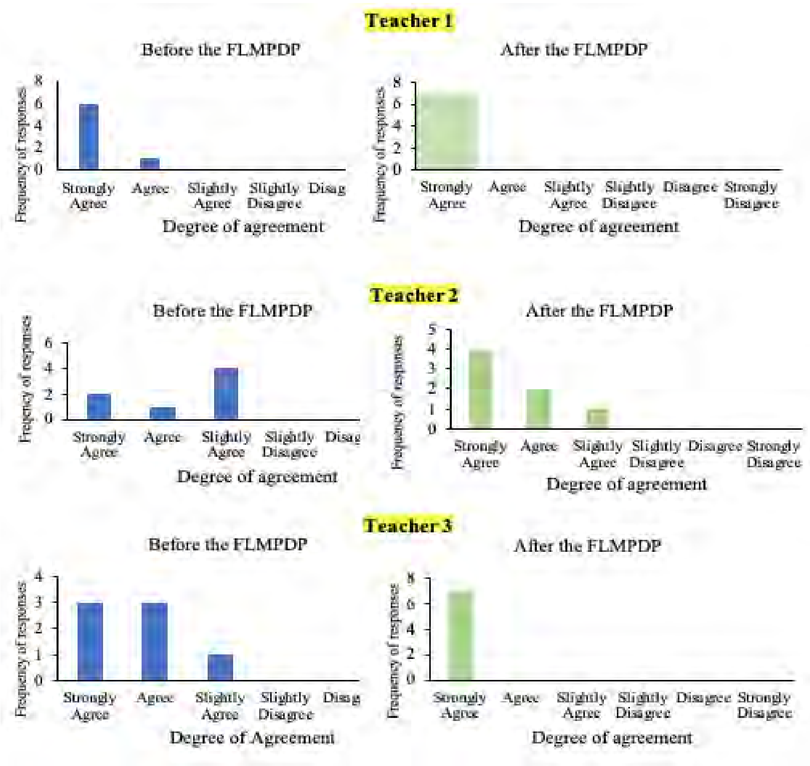

Figure 3. Teachers' Responses to Affective Attitude Before and After the FLMPDP

Consequently, after exposure to the FLMPDP, it can be gleaned how Teacher 1 shifted her answers to all the strongly agreed items. A similar case was also observed in Teacher 3. Previous responses revealed varying degrees of the agreement but have changed into strongly agreeing to all the items of AAT after implementing FLM. Meanwhile, the Teacher's 2 responses were also shifted from *4 agreed* reactions in the initial survey to *4 strongly agreed* answers in the post-survey.

These items that enabled the teachers to change their conceptions were: *I like Formative Assessment (Q1), Formative Assessment is an enjoyable process (Q2), Formative Assessment is interesting (Q3), and Formative Assessment encourages students to help each other (Q5)* and these changes in perspectives imply the effectiveness of the FLMPDP, which significantly affected them to like, be interested and believed in the agreeable process of FA.

According to Yan et al. (2021), if teachers have positive affective attitudes, they would likely implement FA in their classes, which could be manifested in their teachings. The teachers' declarations from the journals and reflections made their teaching experiences more manageable. This affective attitude in showing effective teaching was evident from their statements: (Note: T-1 stands for Teacher 1, and so on.).

> *"In order to achieve my goal for my students, I have provided them with several sample problems as their practice where they need to submit their answers via Zoom chatbox. Not everyone can submit their answers as fast as others can, but* ***I am happy*** *that almost all of them are trying."* **(T-1)**
> *"Utilizing the FLM model in my physics class discussion* ***enables my students*** *to be involved and simulate the concept of kinematics."* **(T-2)**
> *"With the application of FLM, it is* ***easy*** *for us to go through our lessons. It gives us teachers the new teaching techniques and strategies that we could use as we deliver the topics online."* **(T-3)**

They also felt pleased with the result of their teachings, as revealed in the following extracts:

> *"**I am glad** that my students are trying their best to answer every question I pose…* ***I am satisfied*** *with my student's learning for this week because I have seen that most of them are already proficient in solving problems on their own…* ***I find it nice*** *that they are also trying to answer and participate in our discussion..."* **(T-1)**
> *"The presentation of the Feedback Loop Model* ***is great succor*** *to teachers in assessing the learning of their students."* **(T-2)**
> *"The usage of the Feedback Loop Model (FLM**) has a notable impact** on my Physics teaching.."* **(T-3)**

As manifested in their responses, it could be inferred that the effect of the FLM has continually influenced their inherent positive affective attitude. The expressions such as *"I am happy," I am glad…", "I am satisfied…", "… it is easy…", and "I find it nice…*" have shown positive feelings or emotions that characterize an affective attitude. These expressions of satisfaction made their teachings more manageable, especially in the context of the Online Distance Learning (ODL) modality.

This would mean that a positive affective attitude extended its relevance to the online setting, a "new norm" in education based on the terminologies or phrases mentioned, such as *"simulate"* "*new teaching techniques and strategies that we could use as we deliver the topics online," "submitting their answers in our Zoom chat box,"* as these concepts could be associated to the essence of ODL modality practiced in the current setting.

Instrumental Attitude (IAT). To measure the teachers' judgment or perceptions of how advantageous the outcomes of conducting FA in their Physics classes were, a scale in Instrumental Attitude (IAT) was measured. Yan and Cheng (2015) expounded on the advantages of using FA in the student-learning process, emphasizing redesigning teaching and enhancing students' learning. The figure below presents the results, with ten items reflecting the IAT characteristics.

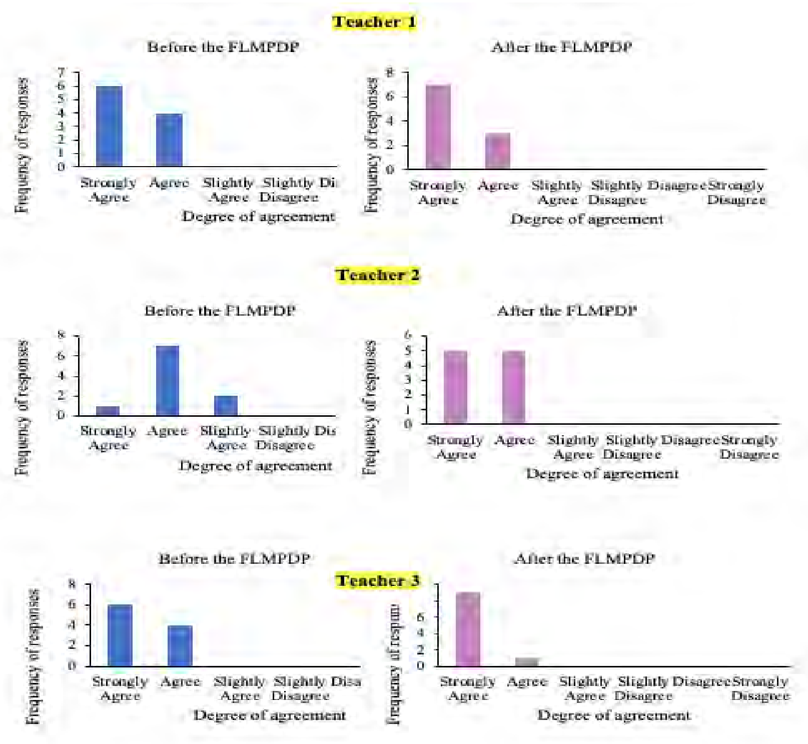

Figure 4. Teachers' Responses to Instrumental Attitude Before and After the FLMPDP

Teachers' responses in the ten (10) items characterizing an instrumental attitude indicated changes in the perspectives of the three teachers. Teacher 1, who firmly acknowledged beforehand the benefits of utilizing FA, can be noted to have further increased her belief in the advantages of FA after being exposed to FLMPDP. An increase in the number of strong agreements showed more substantial views of the positive outcomes when conducting FA based on FLM in their Physics classes. Teacher 2, who had several agreed responses before the FLMPDP, can be noticed to have changed her perspectives after the training workshop. Based on Figure 4, Teacher 2 has amplified her answers in the strongly agreed scale with no slightly agreed responses manifesting positive impacts on the teaching.

Meanwhile, for Teacher 3, there is a firm indication of positive changes as observed based on the increased number of strong agreements before and after being exposed to FLMPDP. This also suggests how Teacher 3 was affected positively by the benefits of FA to students' learning. Particular items that generated shifts of conceptions were found in the following statements describing that FA could encourage students to work harder (Q11), help students understand their strengths and weaknesses through feedback from teachers (Q13), encourage autonomous learning of students (Q14), and improve student's confidence in understanding (Q15). These statements, which yielded significant changes in the teachers' perspectives, were confirmed from their teaching experiences as they implemented FLM in the class. As reflected in their remarks, they believed that FLM assisted them in teaching and learning.

> "***I have seen that my students are actively participating*** *because there are a number of them who always raise their hand to answer each item… I have observed that students are getting better at connecting ideas through a picture… I have also followed a process that has helped me and my students achieve our learning goals."* **(T-1)**
> *"…* ***I learned that students*** *would understand the concept thoroughly if they were performing it. The Feedbacking to the students is frequent since teachers ask what they have learned, what they need to learn, and how they learn."* **(T-2)**
> *"…* ***I also learned in my experience*** *that the FLM could be both beneficial to the teachers and the students…"* **(T-3)**

With the data gathered from the teachers, it can be inferred that they have been confident in using the FLM in their classes. They acknowledged the benefits of the approach in their teachings to meet the objectives of their lessons and process the inferences for them to give informational feedback. Their affirmations on the advantages of using this model were recognized, particularly on implementing it in their synchronous classes. The benefits of providing feedback enabled them to assess their teaching strategies and their students' learning.
Additionally, these benefits manifested how the FLM approach adjusted in the ODL modality. As these processes were applied virtually, the advantages provided by incorporating FA in the students' learning could still be achieved in an online setting.

Self-efficacy (SEF). Self-efficacy can positively or negatively influence people's thoughts (De Smul et al., 2018) and may affect teachers' emotions at work and the conduct of FA in their classes. This construct associated with teachers' confidence and control in implementing FA (Karaman & Sahin, 2017) could provide important information to the assessment practice.

Based on the teachers' initial results, it can be observed that their self-efficacy beliefs obtained diverse claims. Out of the 6 items under this construct, two items, such as *I have received sufficient training to implement (Q28)* and *I have enough time to implement Formative Assessment (Q30),* did not receive strong agreements from Teacher 1. Meanwhile, it can also be noted the average confidence of Teacher 2 is shown in the numerous *slight agreements* of the teacher. For teacher 3, the consistent agreements of her claims in all of the items can be noted. However, as reflected in the graphs (see Figure 5), the three teachers have positively increased their frequency of responses after implementing FLM in their Physics classes. This means that there was conformity to the attributes of the six items under self-efficacy after the FLMPDP, indicating enhanced confidence in integrating FA into their teachings.

Such items that have improved the most were found in Q28 and Q30, stating *that I have received sufficient training to implement Formative Assessment* and *I have enough time to implement Formative Assessment*, respectively. Implications for these improved items could be attributed to the teachers' exposure to the FLMPDP, which empowered them to be confident in conducting FA in the class. This confidence can be further supported by the narratives they have shared in their journals and reflections. The following extracts implied their improved abilities in handling FA using FLM practices.

> *"After all our discussion in kinematics, I can summarize the insights that I have gained by…feedbacking guides students and teachers on the teaching-learning process."* **(T-1)**
>
> *"Utilizing the FLM model in my physics class discussion enables my students to be involved and simulate the concept of kinematics… My principal also gave her feedback about how the class went through if the FLM model was applied. According to her, it is a student center class discussion…. She added that having a tool or simulator during the class discussion can initiate and gather feedback from the students..."* **(T-2)**
>
> *"I learned a lot of things from my experience in applying the FLM on the teaching-learning process. Overall, I must say that FLM brought a huge difference to the teaching-learning process, especially we had this new set-up in new normal."* **(T-3)**

From these perspectives, it can be noted that there were changes in their self-efficacy beliefs. Based on the context of their statements, "*I have learned…", "I can summarize…." "I have given…provided…", "…enables my students…"* signified **improved self-esteem** towards implementing FA. Their efforts to utilize FA practices have shown their certainty and control in conducting it (Karaman & Sahin, 2017). Their handling of tasks and activities revealed their high confidence in corresponding positively to their actual formative assessment practices inside the classroom.

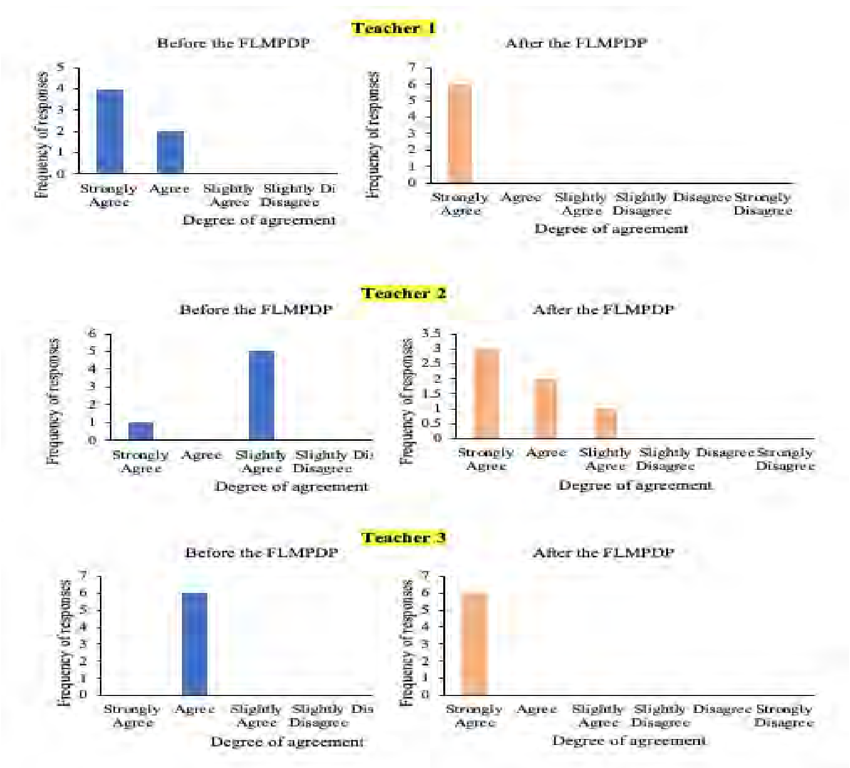

Figure 5. Teachers' Responses to Self-Efficacy Before and After the FLMPDP

These variations of self-efficacy can also be extended in the virtual context. Teacher 2 even shared her experiences when FLM was applied in her class, and according to her principal's feedback, the FLM approach encouraged students' participation indicating a student-centered course. Teachers 1 and 3's acquired learning can reflect their confidence in delivering the topics online. These could be perceived by how they conveyed their statements through actual experiences.

It can then be inferred that the teachers' knowledge, training, and experience from the PDP affected and enhanced their self-efficacy. With the exposure gained by the teachers from the formal training, the more likely they would implement this learning in the classroom. Such results supported Bandura's SCT theory, describing self-efficacy as vital in affecting one's ability to adapt, change and impact other determinants. In addition, personal factors such as self-efficacy beliefs, attitudes, knowledge, education, and training play essential roles in successfully implementing FA in the classrooms (Yan et al., 2021).

Although the SHS Physics teachers' age and teaching experience in this study were less than five years (< 5 years), this did not contribute to affecting their self-efficacy as claimed by other studies (Klassen & Chiu, 2010; Ng, 2020), which instead state that experienced teachers have a thorough understanding of the content and may be associated with more confidence than novice teachers as more innovative and creative with new ideas and methods (Paniagua & Sanchez-Marti, 2018).

This also supports Tshabalala's study (2014), as cited by Mupa and Chinooneka (2015), arguing that the quality of teacher training, regardless of experience, creates an impact on the teaching methods and improvement of skills and teachers who were recently trained may have more to offer because of the new knowledge, skills, and experience. Furthermore, an underpinning theory for TPB (Wong, 2014; Yan & Cheng, 2015) also cited that regardless of age and teaching experience, self-efficacy has an intervening effect on the teachers' implementation because teachers who have strong self-efficacy would persevere in trying it (Dixon & Haigh, 2009). In this case, the higher their self-efficacy level, the more they intend to implement it.

Classroom practices based on FLM. This section explains classroom practices based on Furtak's (2016) model using formative assessment data for science teaching and learning. The frequency of execution or habit of using FA in teaching Physics was determined using the four elements of the Feedback Loop Model regarding how teachers set their *goals,* design, select or adapt the *tools,* collect *data*, and make *inferences.*

Setting the Goals. The goals, which serve as the anchor for the Feedback Loop, must be an explicit declaration or statement of teachers' intentions for student learning in a given interval of time. With the DepEd streamlining the essential competencies and redefining them into Most Essential Learning Competencies (MELCs), setting these goals based on FLM has been more helpful to Physics teachers, as observed from the post-surveys results in Figure 6.

Based on initial findings, teachers' responses when setting goals in the class were practiced well, as shown in their *always and often* responses from the eight items under this construct. The positive changes in their responses before and after the FLMPDP suggested a practical approach to their classroom practices. Specific items that affected the teachers to shift perspectives were found in the following statements, such as *I communicate to my students the intended learning or goals for the lesson (Q1)*; I *believe that constructing clear learning goals can* *increase students' understanding (Q3), I use well-defined learning objectives to help students take more control of their learning (Q4), and I discuss the learning goals many times during the lesson (Q6).*

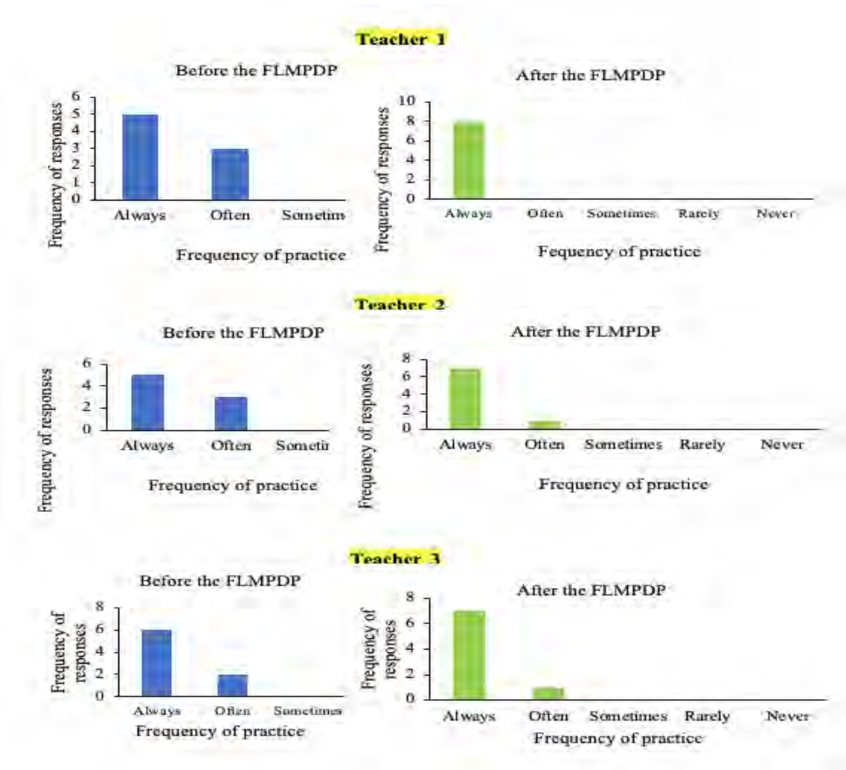

Figure 6. Teachers' Responses to Set the Goals Before and After the FLMPDP

Implications for these changes are attributed to their increased knowledge or understanding when defining or setting the goals. Since Feedback Loop considers the idea of learning progressions as a way of mapping out a sequence of instruction, teachers were able to realize the importance of learning progressions that was characterized by this first element of FLM. Teacher 1, who has changed her viewpoints to *always* (after the FLMPDP), signified an effective change of FA practices in her Physics teaching, and this is supported by one of her statements from the journal expressing,

> *"... I have followed a process that I guess has helped me and my students achieve our learning goals."* **(T-1)**

For Teacher 2, applying the FLM has created multiple opportunities for students to explore the learning goals and, accordingly,

> *"Utilizing the FLM model in my physics class discussion enables my students to be involved and simulate the concept of kinematics."* **(T-2)**

Since student involvement in setting goals is an essential aspect of Feedback Loop, cross-examiners could also observe these qualities. According to their remarks, teachers could utilize student-friendly language, a necessary concept for teachers and students to co-create success criteria. These details were evident in the provided extracts. (Note: CE-1 stands for Cross-examiner 1, T–1 stands for Teacher 1, and so on)

"*… It is also written in simple language that the students can understand...*" **(CE-3 on T-2)**
"*... in a language or analogies that are student-friendly.*" **(CE-1 on T-1)**

In the Feedback Loop, the idea of learning progressions as a way of mapping out a sequence of instruction could help teachers locate the places in their teaching at which it is most critical to stop and find out what students have learned so far. And this aspect was practiced by Teacher 3. According to the extract,

"*... Through this, I will also know if the students met the objectives provided or introduced to them.*" **(T-3)**

Even one of the cross-examiners has observed this and commented on the following statements,

"*Students clearly understand the objectives and know what is expected of them and how this relates to the overall objectives of the course. He gives enough and simplified examples of every item.*" **(CE-2 on T-3)**

Based on the gathered information under this element of the Feedback Loop, it can be observed how teachers' classroom practices in setting the goals positively affected their teaching.

Designing, Selecting, and Adapting Tools. In the case of tools, which create opportunities for teachers and students to bring to the surface data about what students know and can do relative to the goal. Teachers' responses indicated enhanced practices of designing, selecting, and adapting tools. The typical responses of the three teachers of always (after the FLMPDP) creating opportunities to surface valuable data have shown positive changes in their classroom practices toward FA.

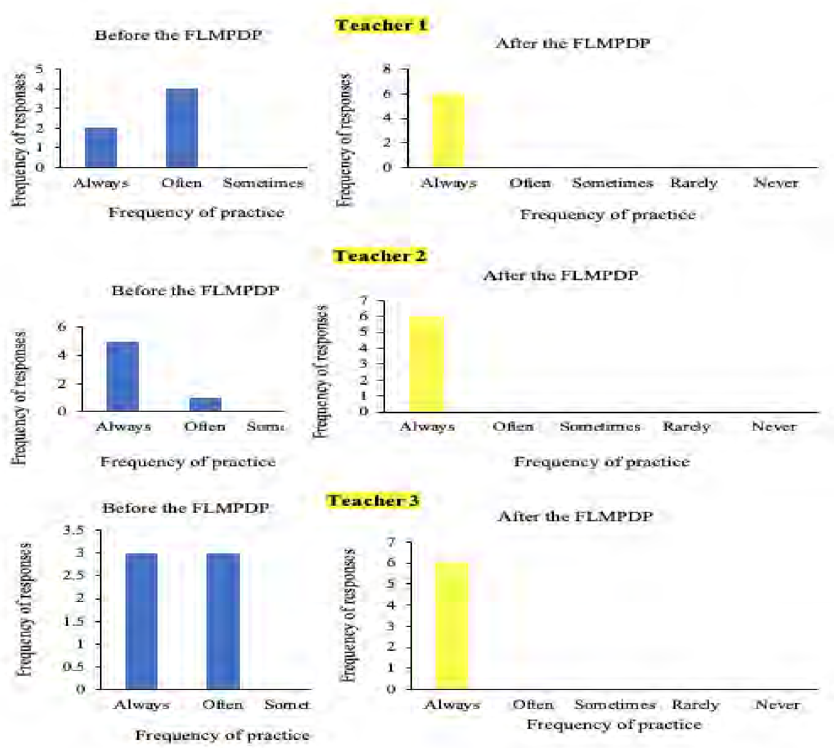

Figure 7. Teachers' Responses to Designing, Selecting, and Adapting Tools Before and After the FLMPDP

Before the FLM approach, teachers' responses were either agree or the often scale of agreement; however, these were observed to change after implementing FLM, as evident in Figure 8. Teachers' conceptions of the *tools* have significantly improved and showed confidence in *designing learning tasks to capture students' understanding (Q10) and easily select or adapt tools to assess their thinking (Q11).* Their enthusiasm *to probe students with follow-up questions for an in-depth undertaking (Q13)* was also regularly practiced. These implications by the teachers claiming improvement are attributed to their enhanced knowledge, skills, and confidence in implementing FA. The FLMPDP, which trained teachers to use and explore other ICT tools in surfacing students' ideas, helped them design, select and adapt to the "new norm" of teaching.

Their reflections indicated their confidence in planning ranges of instructional approaches using ICT tools that could surface data about their students' thinking, just like how the three teachers planned out their lessons based on these extracts.

> *"I have provided students with a picture to analyze and differentiate the horizontal and vertical motions of two balls launched at different speeds. Guide questions are provided in each part of the discussion. I have learned that follow-up discussions and different types of assessment tools that challenge students' critical thinking skills are helpful to achieve the intended goal for a lesson."* **(T-1)**
> *"Students are engaged in the simulating activity, and they are the ones who provide the ideas, meaning, and information related to the topic based on their observations."* **(T-2)**
> *"The students are not only listening to the class discussion but also simulate the concept of uniform motion. They differentiate the object's position, velocity, and acceleration with different time intervals. The students, during the simulation activity, can understand the concept and predict what will be the result if there is a change in position, velocity, and acceleration in different time intervals. They anticipate how an object sustains a uniform motion."* **(T-3)**

Aside from these perspectives coming from the teachers, these were further supported and verified by cross-examiners or experts. According to their observations, various discussion tools were found in the synchronous classes of the three Physics teachers.

> *"The use of the zoom portal allows the teacher to use different instructional approaches such as whole group teaching, small group work (via breakout rooms), individual and reflective work."* **(CE-3 on T-1)**

Cross-examiners have also observed that the classroom set-up of SHS Physics teachers regarding the range of instructional approaches was extensively maximized. According to them,

> *"Though the class is held online, the teacher provided a variety of instructional approaches, teaching pedagogy, and different students' collaboration and interactions. It allows every student to proper learning and assimilation of knowledge."* **(CE-2 on T-1)**
> *"The zoom enables the teacher to use whole group teaching, small group work and individual works."* **(CE-3 on T-2)**
> *"Zoom portal can accommodate different teaching strategies such as whole group teaching, small group teaching, individual and reflective work."* **(CE-3 on T-3)**

In the case of teachers developing tools that help students assess and monitor their progress, a few comments were evident such as,

> *"The teacher provided some tools for student's assessment as well as feedbacking. She made the lesson as simple as possible for students to clearly understand it better through incorporating some online assessment tools."* **(CE-2 on T-1)**
>
> *"Students have multiple opportunities to explore learning goals because the teacher used different strategies in the discussion. She used graph simulations and videos."* **(CE-3 on T-2)**

This information suggests that the teachers displayed flexibility in selecting appropriate tools to be adequately used in their online teaching. Based on the experts' remarks, the teachers created adequate space for students to participate even in an online class.

Collecting Data. Data in the Feedback Loop are constituted by multiple sources of information about student thinking generated by the tool(s). Teachers select and design the tools aligned with the goals, creating data that are useful in determining what students understand and can do. Based on the teachers' theoretical agreement found in Figure 8, positive transformations in their perspectives could be noted. More responses could be observed in the "always" scale, indicating their consistent practice in collecting data using FLM compared to their previous answers.

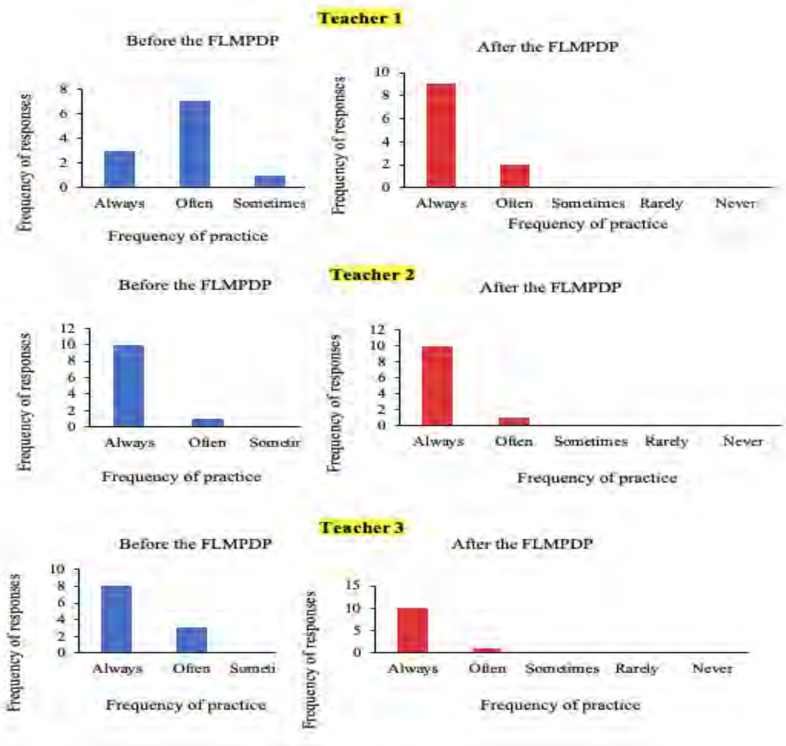

Figure 8. Teachers' Responses to Collecting Data Before and After the FLMPDP

Items such as engaging students in small group discussions (Q15), interpreting students' ideas correctly when using varied forms of data (Q20), and providing support to students without taking over by using thought-provoking questions rather than explanations or direct instruction (Q22) are some of the statements that have shown improved practices. These imply that teachers' have gained knowledge of the numerous ways of collecting information from the students. Their journals and reflections indicated how collecting data from students' ideas and thinking helped them plan their instructions. These claims are manifested in the following extracts made by teachers, such as:

> *"... During this activity, I have seen that my students are actively participating because there are a number of them who always* ***raise their hand to answer each item****."* **(T-1)**

The raising of hands which is quantitative data, could be used by teachers to keep track of how a lesson is going. Meanwhile, for Teachers 2 and 3, students' ideas were assessed based on the data students shared in their synchronous classes, and these were revealed in the following extracts.

> *"In the introduction of our lesson, the students share their insights."* **(T-2)**
> *"The use of formative assessment provides an advantage like, for example, it can provide me data about the prior knowledge of my students and not just that, but I can easily identify if the students understand the lessons very well."* **(T-3)**

Likewise, cross-examiners were able to show evidence showcasing the progress and process of students employing brainstorming, students asking questions, or feedbacking. These multiple sources of information could help determine what students understand and can do.

> *"Indeed, the teacher incorporated various ways of tapping and evaluating students learning through ... allowing each to explore how far they have mastered the lesson by participating in classroom interactions and exercises."* **(CE-2 on T-1)**
> *"Though the class size is small, the teacher made sure to have an interaction with the students through* ***Quescussion*** *– Question, and Discussion."* **(CE-2 on T-3)**
> *"... Student participation to teacher's question signify student progress as well as student work."* **(CE-1 on T-3)**
> *"... Feedback is also immediately given to the students after they answered the questions..."* **(CE-3 on T-2)**

According to studies (Buck and Trauth-Nare, 2009; Gearhart et al., 2006; McMillan, 2003), teachers tend to select more effective strategies in helping learners achieve a more profound conceptual understanding if they understand learners' thinking. Also, teachers strengthened their interpretations of students' work, improved the specific learning goals, and enhanced the quality of assessment tasks when they utilized cycles of assessment implementation and reflection. If teachers reflected on the collected data (assessment conceptions) and their beliefs, this could lead to self-awareness of their interpretations or judgments that could influence assessment processes. Thus, based on these multiple pieces of evidence, it can be inferred that teachers' classroom practices in collecting data were improved significantly in this digital era.

Making Inferences. The final step of the Feedback Loop is where everything comes together when you compare the data you collected using your tools to make inferences about what students know relative to the goals you established initially. In this element, teachers' initial responses entailed less conformity to the items. However, upon incorporating the FLM approach of making inferences, the progressive changes in the agreements of the three teachers can be revealed. Descriptions such as I encourage my students to write feedback in helping other students improve their tasks (Q26), I engage my students to do peer assessment (Q27), and I analyze students' recorded ideas and picking up on themes (Q31) are some of the items that have shown progressive changes from the teachers' responses. These suggest the teachers gained understanding and enhanced capability in making inferences on the data collected.

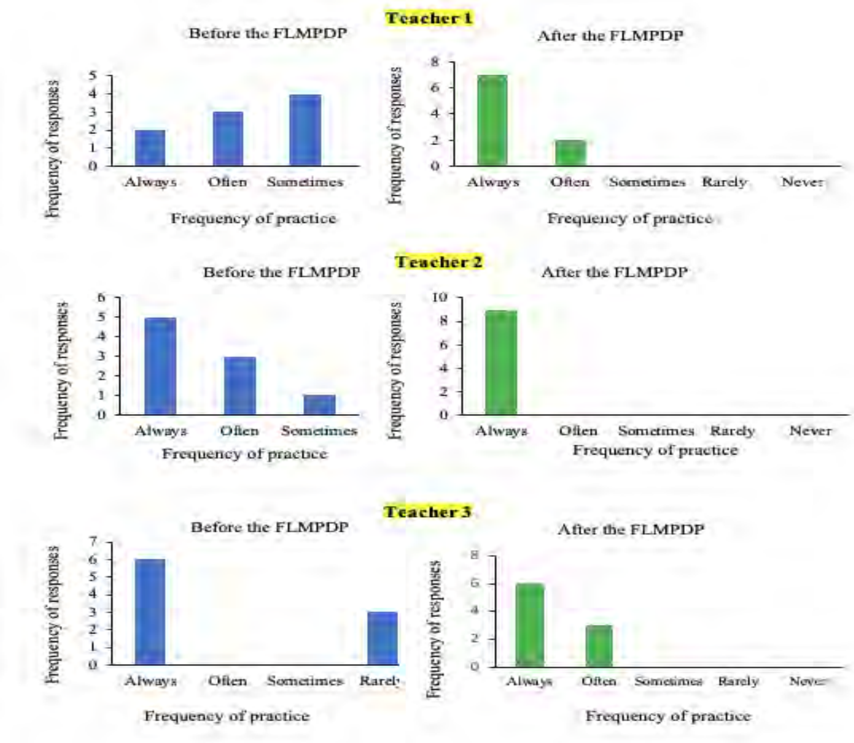

Figure 9. Teachers' Responses to Making Inferences Before and After the FLMPDP

Based on the narration of the teachers, it could be shown how this aspect of making inferences enhanced their capabilities.

> *"The data showed a successful result on the problem- solving. But I have observed that very few students are careless in putting their input values in the calculator, resulting in wrong answers. Also, some failed to analyze the problem before answering them. The overall result showed proficiency in their problem-solving skills, and I can infer that the goal has been achieved."* **(T-1)**

Teacher 1, who carefully assessed her students' outputs, is an excellent example of making inferences. The information she gathered could address students' problems or current understanding and, from there, be used to improve her teachings.

Meanwhile, Teacher 2 could infer that students better understand the lessons if they were involved in the process. According to the extracts,

> *".. The students, during the simulation activity, can understand the concept and predict what will be the result….*

> *They anticipate how an object sustains a uniform motion... I learned that students would understand the concept thoroughly if they were performing it."* **(T-2)**

Similarly, Teacher 3 could easily decide on the next step of his teaching by adding more exercises because of the implications he received from the activities' results, which could be seen in the following extracts.

> *"The data showed a successful result on problem-solving. Almost all have passed the quiz. However, some students have difficulty analyzing graphs and directions of the velocity and acceleration. With this, additional exercises on picture analysis should be given."* **(T-3)**

Furthermore, external validators or cross-examiners were able to support these attributes because of the various comments they noted for each teacher. According to the cross-examiners' observations, the Physics teachers' practices in giving descriptive feedback were in the Improving Practice (IP). Teachers' feedback was aligned with the learning goals, and students recognized their accomplishments and ideas. The following extracts supported these observations:

> *"Effective descriptive feedback practices were evident... students' questions are also entertained... enough time is given to assess each student's understanding about the concept."* **(CE-3 on T-1)**
> *"The teacher constantly asks questions after each short discussion to gauge student learning."* **(CE-3 on T-2)**
> *"The teacher provided feedback by asking check-up questions concerning the subject matter."* **(CE-1 on T-3)**

Given this valuable information, the inferential process, a core aspect of formative assessment (Bennett, 2011), enabled the teachers to refine their inferences about what students know and could do. Hence, it could be manifested in the three teachers' responses about how their enhanced process of making inferences affected their classroom practices toward FA.

All in all, the Physics teachers in this study exhibited all the key elements needed to build a classroom environment that supported formative assessment, as transpired in the comments and remarks from the cross-examiners. This implies that the SHS Physics teachers were able to manifest and build a classroom environment that supports formative assessment. Although the tool was designed face-to-face, implementing FA in an online setting could be achieved. With the Feedback Loop Model (FLM), a manageable and concentrated procedure of checking for and reinforcing the understanding that is specific, non-evaluative, and focused on a learning target through feedbacking, teachers could explicitly give a practical formative assessment to improve student learning.

Conclusion

This study has determined the changes in the 3 SHS Physics teachers' attitudes, self-efficacy, and classroom practices toward FA as they implemented FLM in their classes. Based on the findings, teachers' initial surveys revealed diverse theoretical agreements concerning their attitudes (e.g., affective and instrumental attitudes), self-efficacy beliefs, and classroom practices toward FA. However, after implementing FLM in their teaching, significant changes were observed. These changes were manifested qualitatively, as supported by their theoretical agreements using the same initial surveys, teachers' journals, reflections, and cross-examiners' observations on their recorded online classes.

Implications of these results suggest the positive effects of the FLMPDP that intended to strengthen the practice of FA in the class. Teachers' attitudes, self-efficacy, and classroom practices on FA were affected significantly, leading to a more enhanced positive mindset of utilizing the assessment and gained self-confidence in applying it. Moreover, teachers were able to manifest and build a classroom environment that supports formative assessment. With the Feedback Loop Model (FLM), a manageable and concentrated procedure of checking for and reinforcing the understanding that is specific, non-evaluative, and focused on a learning target through feedbacking, teachers could explicitly give a practical formative assessment to improve student learning.

However, the limitations of this study could be attributed to the few teachers who were willing to implement FLM in their Physics classes. If more teacher-participants were involved, more feedback could support and substantiate the study. Also, besides being exposed to the webinar series provided for the teachers, continuing it in mentoring and coaching sessions could augment their knowledge and skills.

Recommendations

It is recommended that more teachers be involved during the implementation phase of the study, conduct further investigation into other Physics or science topics, and enforce mentoring or peer coaching sessions to supplement teachers' knowledge and skills. This way, teachers would have opportunities to refine the strategies they learned from the PDP and enhance collaboration and growth. Students' participation through interviews could have supplied more details about their experiences when the teacher implemented the FLM. Data acquired from it may be used to augment further and triangulate the findings. Future research in strengthening online formative assessment is a warranted and timely research topic in this ODL modality. Therefore, expanding its ideas and concepts like the Feedback Loop as a formative assessment data for science teaching and learning can potentially reinforce professional developments for teachers. Investing in the teachers' professional growth in training them denotes effective learning based on empirical evidence.

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