The Philippine K to 12 Science Curriculum in Thematic Instruction: Perceived Effects on Students' Scientific Attitude

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Abstract –*In an attempt to explore alternative ways of delivering the competencies in the Philippine K to 12 Science Curriculum, the researchers implemented thematic instruction. Using a thematic instructional model, the researchers identified four themes in which science instruction for a grade 7 class proceeded. In effect, how thematic instruction influenced the development of scientific attitudes, as one of the curricular outcomes, among students was studied. In the conduct of the study, an exploratory research design was used. The observations of twenty-two (N=22) pre-service teachers and the experiences of thirty-six (N=36) grade 7 students were analyzed to determine the perceived effects of the thematic instruction. The analysis of the data shows that thematic instruction seemed to enable students to realize the different scientific attitudes identified in the literature gathered. Moreover, the results of the study showed that through thematic instruction, students were developed to be curios and be active listeners in their science class. Lastly, the results of the study seemed to imply that thematic instruction can aid in the implementation of the K to 12.*

Keywords –*Philippine K to Science in thematic instruction, thematic instruction, and scientific attitude, thematic instructional model*

INTRODUCTION

Thematic instruction has been reported by many researchers as an effective strategy in delivering curricular competencies. It is a process of teaching where the integration of competencies is centered on a common topic or a theme [1]. With an identified theme, learning experiences and other school-related activities are designed [2]. Primarily, thematic instruction is to promote meaningful learning [3] by identifying ideas that interest students [4] and build the teaching-learning tasks about them. [5] agree that thematic instruction is for meaningful learning for it promotes multiple cognitive relations among students.

With the numerous benefits of thematic instruction, the researchers explored how in particular the mode of instruction affects student's scientific attitude. Though several pieces of literature enumerate literature the benefits of thematic instruction on student outcomes, a dearth on how the strategy promotes scientific attitude has been found. In effect, the results of the present are to inform educators of the said research gap.

Moreover, the present research is an attempt to explore an alternative mode of delivering the K to 12 science competencies of the Philippine K to 12 Curriculum. While the present K to 12 science curriculum design arranged the competencies in themes related to the nature of the science discipline (Earth Science, Biology, Chemistry, and Physics), the present study explores another them that are based on the Department of Education's core values—self, environment, country, and Earth and Universe.

With the said curricular innovation of the researchers, this study seeks to determine if the strategy has the potential to contribute to achieving the K to 12 Science Curricular goals. Therefore, the implications of the results of the present study to the current science curriculum of the country are also discussed.

Scientific Attitude

Research supports that among the different domains of learning, scientific attitude is an affective construct. Scientific attitudes are the complex set of values and norms that are held binding to the person who is studying science [6]. The said norms are expressed in varied forms and are influenced greatly by institutional values. The said values influence an individual's preference, acceptance, appreciation, and commitment to science [7]. Further, [7] stressed that the most prominent quality of scientific attitude is the evaluation of the directionality of a person or how he or she feels towards a concept either positively or negatively. Therefore, the present research posits that scientific attitude describes the person's feelings toward, either for or against, a concept, idea, or even a person of science.

The scientific attitude of students affects their way of learning science. According to [8], scientific attitude is actually 'habits of the mind' that embody the adoption of a particular approach to problem-solving methods, assessment of ideas and information, and even concluding. [9] agreed that scientific attitude partnered with scientific skills to determine scientific literacy. Thus, to promote scientific literacy among students, the development of scientific attitude is fundamental.

With the importance of promoting scientific attitude among students, schools strive to improve their inclusion in the curriculum. Acknowledging the contribution of scientific attitude in improving student's achievement in science, [7] determined that scientific attitude to be a long-term legitimate goal of science education. However, the wide range of the scientific attitude concept confuses it with other constructs (values, beliefs, interests, and opinions) according to[7]. Thus, if looked intently scientific attitude can be differentiated from the said constructs.

To establish a common concept of scientific attitude, it is essential to determine its difference with another construct being confused with it. First, values are the set of rules that direct moral and ethical decisions of a person; such direct one's judgment of right and wrong. Values differ from attitude since is it has a broader concept and is always referred to as positive in nature. The complexity of the person's values-system makes its less easily changed. Second, the relationship between objects and attributes makes a belief. Thus, belief is a cognitive basis for attitude. Beliefs provide information for attitude by linking the characteristics of the objects and their characteristics. Third, interests described the process when a person learns to develop a positive attitude towards a certain idea, object, person, and many more. The responses that a person may give when asked about interest can be ranked from a certain degree of like and dislike spectrum. Lastly, opinions on the other hand are more cognitive than attributory. Compared to attitude, the utilization of the term opinion is not used in science education researches since it can be subdued under attitude, value, and belief.

How do students acquire a scientific attitude? Attitudes are learned either actively or vicariously, thus they can be taught [7]. With such nature of attitude, it can be susceptible to change but is stable enough to be enduring. Attitudinal change can be influenced by several factors which are the object to which attitude is directed to and the level of consistency of behavior with personal, social, and cognitive variables. Further, the psychological theory called the Elaboration Likelihood Theory Model (ELM) by [10] describes how attitude change may happen. The ELM describes seven major approaches to promote attitude change which are conditioning and modeling, message learning, judgmental, motivational, and attributional, combinatory, and self-persuasion. However, [7] describes that among the different approaches to attitude change, persuasion is one common method that emerges. Persuasion according to [10] is a change in attitude upon being exposed to communication. Thus, persuasion can be correlated with classroom instruction. Therefore, in this case, thematic instruction is hypothesized to persuade students to possess a better scientific attitude in the classroom.

Classroom instruction that seeks to invoke in students a change of attitude does not call for a long implementation time; what is important is the method of how to communicate with students to persuade them to change their attitudes to be manifested in their behavior. In the present study, the thematic instructional model being designed aims to improve students' scientific attitudes by presenting lessons that they can practice or even promote scientific attributes. Students are exposed to activities where they must exhibit scientific attitudes described in the literature of this study. The literature reveals that by intentional persuasion of students through appropriate communication they will be able to develop a change of scientific attitude.

Attributes of Scientific Attitude used in the Study

In the Philippines, a set of scientific attitudes has been discussed in the Science Curriculum Framework by the SEI-DOST & UP NISMED [11]. The said scientific attitudes are:

Critical Thinking describes all thinking processes that enable a person to investigate a problem and determine how it can be resolved by understanding in totality. Critical thinking skills employ subskills such as questioning, probing, analyzing, testing, and exploring. In general, critical thinking can help students to have better grades, become responsible for their learning, create knowledge, and evaluate existing structures that may be further clarified. Students' mastery of critical thinking skills can lead to lifelong learning.

Curiosity makes a person desire to know or learn by asking questions on his surroundings, occurrences in his environment, and even the origin of things. When a person knows how to ask questions, he will have the desire to investigate it and eventually lead to the conduct of scientific investigations.

Creativity is the ability to put things together in a new way, seeing connections between ideas that seem unrelated, or by changing one's perspective towards an idea. Creativity leads to relevant and innovative ways of problem-solving.

Intellectual Honesty means not copying others' work and claims it to be one's own. Being intellectually honest means being not selective of reporting the results to favor one's hypothesis and expectations. It is also giving credit or acknowledging the person from whom an idea was derived or based.

Accuracy is shown when the result or the output of a scientific task is free from errors or blunders by careful observation, description, and measurement during the problem-solving task.

Objectivity is being able to deal with facts or conditions as they are without being biased. An objective person does not let his or her feelings, prejudices, and expectations get in the way of his or her quest for answers. Validating observations and explanations is a process always done by an objective person.

Independent Thinking is answering the question using a students' observation and experiences. An independent person uses his or her mind in looking for relevant data and information and does not simply accept ideas and opinions from others to come up with his or her judgment on a matter. An independent person is not afraid of using his or her mind in making decisions even if it may lead to incorrect conclusions.

Active listening is learning from other people by carefully listening to what others are saying and exerts effort to understand what is being said. Active listening is also a way of participating in a discussion and lobbying arguments if it is contradictory from one's point of view.

Assuming responsibility is carrying out a task to the best of a students' ability. *Taking initiative* is realizing that there is a task that must be accomplished and does it without being asked. A person with the initiative is keen on providing action when it is needed. *Perseverance* is carrying out tasks despite the challenges being faced such as failure of research results, disappointments on the task, an unsatisfactory outcome. A person who perseveres will most likely succeed because of not giving up until the desired solution is achieved.

OBJECTIVES OF THE STUDY

The present study explores how thematic instruction affects students' scientific attitude. Specifically, the following are the objectives of the study: determine if thematic instruction promotes the varied identified scientific attitude among students; identify which scientific attitude is best or least promoted by thematic instruction

METHODS

Research design

The present research explores how thematic influence the scientific attitude of students. Therefore, an exploratory research design was used. Figure 1 shows how the said research design guided the conduct of the study.

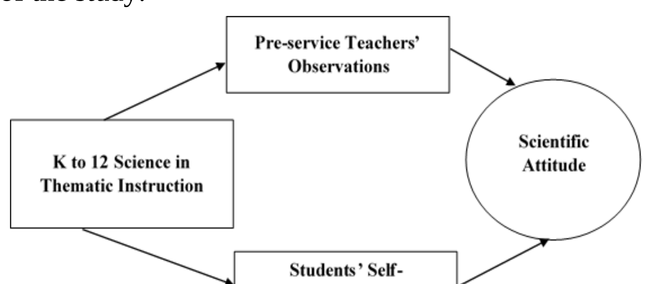

Fig. 1. Research Paradigm in exploring the effects of thematic instruction on students' scientific attitude

In the conduct of the study, the researcher followed the thematic instructional model (TIM) by Montebon and Orleans [12]. In the said model, the different competencies for grade 7 of the K to 12 Science Curriculum were integrated into for themes identified by the researchers. From the said themes, instructional plans have been developed and implemented in the classroom.

In contrast with the current design for the K to 12 Science Curriculum of the country which clusters lessons across science disciplines, the thematic instruction referred to in the study is the delivery of the competencies cantered around the themes identified: Self, Environment, Country, and Earth and Universe. As an example, the theme *Self* covers concepts such as cells as the basic living component of the body, elements, and compounds as non-living components of the body, and sound to describe how the body functions. With such design, it can be noticed that concepts coming from different science disciplines were integrated to teach competencies that will make the students understand themselves.

As the lessons were conducted, pre-service teachers who were assigned as observers analyzed classroom procedures and interactions to describe student scientific attitudes using a classroom observation tool. On the other hand, the students who participated in the study were asked to report their experiences with thematic instruction through a questionnaire and an interview to also describe their scientific attitude.

The data that were gathered are both qualitative and quantitative. To accurately answer the specific research questions asked in the study, the researchers used a multi-method research design.

The research locale and period of study

The present research has been conducted at a laboratory school of a teacher education institution. With the nature of the research locale, the researchers were able to deviate from the prescribed delivery of instruction for science. Specifically, the thematic instruction was implemented in a grade 7 science class. The implementation of the thematic instruction lasted about three quarters of a certain school year.

Participants of the study

There are two groups of participants in the present study—the pre-service teachers (PTs) and grade 7 students. The PTs who participated in the present research were composed of twenty-two (N=22) biology majors who are having their field study courses at the research locale. In groups of two, they have observed the grade 7 science class which is taught through thematic instruction.

On the other hand, there are about thirty-six (N=36) student participants, 16 males, and 15 females, who were exposed to thematic instruction. However, not all did not participate in the data-gathering processes. 20 students participated in the interviews while 31 students answered the questionnaire.

Research instruments and data gathering procedures

To obtain relevant data for the study, there were several research instruments were used and procedures were conducted. For the PTs to observe the Grade 7 science class, they were oriented with the classroom observation tool (COT) designed by the researcher. Using the COT, the PTs identified if they have observed the different scientific attitudes listed. Since there are 2 PT observers for each lesson, each pair discussed the differences in their observations and come up with a consensual rating. Moreover, the PTs were asked to write down their specific behavioral observations in each class to support their rating in the COT. In total, there were 20 observations gathered for the whole duration of the study.

Another research instrument that was used in the study is a researcher-made questionnaire given to students that asked the level of agreement on statements that describe their scientific attitudes. The contents of the questionnaire were modified from the list of scientific attitudes described by [11]. Upon validation and pilot testing, the questionnaire gathered an acceptable reliability alpha coefficient (α=0.899).

Lastly, to support student's self-assessment ratings on their scientific attitude, they were interviewed by the researchers. Specifically, they were asked to describe how they feel about their science class and the significant experiences they had in their science subject.

Data analysis procedures

The multiple data gathered through the research instruments and interviews have been subjected to appropriate analysis procedures. First, a frequency count was conducted and ranked to report the number of times a certain scientific attitude was observed by the PTs. In the discussions of the results, the frequency of observations was supported by the student behavioral observations of the PTs.

Second, the results gathered from the questionnaire were analyzed using descriptive statistics--the mean. In the discussion, the results of the interviews were used as supporting observations. Subsequently, to graphically describe students' experiences on thematic instruction, the word cloud output generated from the NVIVO software is presented.

Lastly, to determine which scientific attitude is best or least promoted by thematic instruction, the results of PT's observations and student self-assessment report were integrated. To integrate the said results, the researchers ranked independently the frequency of observations of the PTs and the reported mean scientific attitude by self-assessment report. Both ranks were averaged and reported as final ranks of each scientific attitude.

Ethical considerations

In the conduct of the study, the researchers sought the voluntary participation of the pre-service teachers while parent consent has been obtained for the student participants. No monetary incentive was given to both research participants.

RESULTS AND DISCUSSION

Upon the conduct of the different research procedures, this section of the paper reports the results of the said processes.

Table 1. Frequency of Scientific Attitude

Scientific Attitude	Frequency
Curiosity	18
Critical Thinking	16
Objectivity	15
Active Listening	15
Independent thinking	13
Intellectual Honesty	10
Creativity	10
Taking Initiative	8
Assuming Responsibility	8
Accuracy	7
Perseverance	0

*N=20

The summary of the PT's observations through the COT is reported in Table 1. 'Curiosity' is the scientific attitude that has been most observed by the pre-service teachers. The indicators to show evidence of curiosity were varied. PT1 described students to have shown *"genuine interest for science"* or a sincere attitude to learn and understand the lesson. On the other hand, PT 4 described students to be curious for they often asked questions in class and PT 24 agrees that students showed development with their questioning skills. In terms of how the thematic instruction promoted curiosity among students, PT 18 said, *"They become more curious about the relationship of one lesson to another".*

The scientific attitude with the next highest frequency is critical thinking. The PTs acknowledged that thematic instruction promoted students to exercise their critical thinking. According to PT 11, the experiences provided among students equipped them with scientific skills such as critical thinking. Specifically, BPT 16 described that the students were able to display critical thinking by engaging in scientific inquiry. Lastly, BPT 20 indicated how the thematic instruction helped students in developing critical thinking: *"The students had improved their scientific attitude on critical thinking and meaningful learning. This is through connecting previous knowledge from the existing information".*

Objectivity and active listening have been equally observed by the PTs in the form of student logic shown in their science class. On the other hand, PTs described students to be active listeners for they have shown enthusiasm and interest in their lessons and have actively participated in class. According to PT23, "*Students were able to manifest the scientific attitude inculcated to them in performing activities as well as participating/ sharing their ideas to the class."*

The response of PT 14 which is *"[t]he students can give scientific reasons to support their answer with some facts about science"* had been classified as a form of a scientific attitude called---independent thinking. According to the PTs, students were able to practice skills such as scientific reasoning, confidence in classroom tasks, and being open-minded to corrections.

Other scientific attitudes that were observed by the PTs through the COT are creativity, taking initiative, and accuracy. Such scientific attitudes are described in the following responses:

- Creativity – *"Since thematic teaching promotes/ relates whole concepts up to core contexts, scientific attitudes can develop through connecting themes into real-world examples and applications."* (PT 7)
- Taking Initiative – *"The students exercise their collaboration skills as they actively participate in group activities."* (PT 26)
- Accuracy – *"The learners were able to execute/ demonstrate scientific inquiry"* (PT 3)

Lastly, though the scientific attitudes intellectual honesty and assuming responsibility were observed in class through the COT, no responses from the PT where noted on the said attitudes. Interestingly, a notable scientific attitude that was not observed in the COT was the scientific attitude of perseverance. The PT's were not able to observe that any classroom activities were able to enhance students' ability to persevere in classroom tasks.

Students Self-Assessment Report on the Scientific Attitude

In the previous section, the researcher had established the different scientific attitudes that have been promoted in the classroom as students learn science through thematic instruction. In this section of the paper, it is discussed if the said scientific attitude has also been observed by the students themselves. Such a report is shown in Table 2.

Table 2. Student's self-assessment of their scientific attitude through thematic instruction

Scientific Attitude	Mean	SD
Active Listening	4.35	0.80
Objectivity	4.32	0.60
Curiosity	4.26	0.58
Creativity	4.26	0.62
Critical Thinking	4.23	0.76
Assuming Responsibility	4.19	1.01
Intellectual Honesty	4.13	0.62
Perseverance	3.97	0.88
Accuracy	3.94	0.85
Taking Initiative	3.94	0.85
Independent Thinking	3.84	0.86

*Note: 0.1 to 1.0 = strongly disagree; 1.1 to 2.0 = disagree; 2.1 to 3.0 = uncertain; 3.1 to 4.0 = agree; 4.1 to 5.0 strongly agree

As Table 2 shows, all the scientific attitudes described in the researcher-made questionnaire have been realized by the students as they indicated responses that ranged from agreeing to strongly agree. Such results seemed to affirm the observations of the pre-service teachers that the thematic instruction enabled students to manifest scientific attitudes in their science class.

Further analysis shows that among the different scientific attitudes described, it is active listening that accounted for the highest agreement (M=4.35, SD=0.798). It means that students in their class find that thematic instruction motivated them to participate in classroom discussion and activity.

With the said results, the researcher asked why did the students feel that they were actively listening in their science class? Such a question seemed to have been answered by the results of the student interviews on how students feel about their class. A word cloud is generated from NVIVO that depicts the said result.

Fig. 2. Word Cloud on Student Attitude towards their Science Class

From the word cloud in Figure 2, it can be said that students had fun in their science class; consequently, such perception of students manifest their motivation towards the science subject as supported by other adjectives they used to describe their class---easy, interesting, and enjoyable. The students also manifested their reasons why they were motivated in their science class:

- *"It was fun because there are many activities"* – B1
- *"The teachers utilized different strategies in teaching."* –B5
- *"Because I got the chance to learn and discover new things"* – G10

As described in the literature, active listening is an effort to understand what is being taught in class by exerting effort, paying attention, and showing participation [11]. In other words, active listening is primarily triggered by interest and motivation. As shown in their responses, the students reported their interest and motivation in class. The student participants seemed to find the activities provided in their science subject taught through thematic instruction to be meaningful and interesting that encouraged them to actively listen and participate in the activities.

On the other hand, the scientific attitude that indicated the least agreement is independent thinking (M=3.84, SD=0.86). Independent thinking in the questionnaire means that the TIM supports students to make decisions on their own. Meanwhile, it is interesting to see that while students reported that their science class seemed to help them with their scientific attitude in cognitive forms, their science class seemed to need to improve in providing them activities to practice scientific skills such as perseverance, accuracy, and taking initiatives (all Ms < 3.97). Though the item reported still on the "agree" scale, students did not observe that their experiences in their science class encouraged them to be independent and perform activities on their own.

The said result on students' least agreement on independent thinking and observations on conducting scientific activities corresponds with the results of the interviews that no response was recorded to acknowledge that the thematic instruction implemented helped students process and analyze data.

In response, the researcher cites one limitation of the study that seemed to affect its implementation---time. With a short period that was given to conduct the study, most activities that were implemented are all teacher-directed inquiry to manage instruction on time. It would be interesting to note if the same result will be observed should the implementation of the study be made longer.

Table 3. PT Observation and Student Self-Assessment

Scientific Attitude	*f* from COT	Sub Rank	M on Self-Assessment Report	Sub Rank	Mean Sub Ranks
Active Listening	15	3.5	4.35	1	2.25
Curiosity	18	1	4.26	3.5	2.25
Objectivity	15	3.5	4.32	2	2.75
Critical Thinking	16	2	4.23	5	3.50
Creativity	10	6.5	4.26	3.5	5.00
Intellectual Honesty	10	6.5	4.13	7	6.75
Assuming Responsibility	8	8.5	4.19	6	7.25
Independent thinking	13	5	3.84	11	8.00
Taking Initiative	8	8.5	3.94	9	8.75
Perseverance	0	11	3.97	8	9.50
Accuracy	7	10	3.94	10	10.00

Table 3 shows the juxtaposed data between pre-service teachers' observations and students' self-assessment on scientific attitude. Looking at the data in Table 3, almost all the scientific attitudes identified in this study have been observed by both PTs and were realized by students as they were taught through the thematic instruction. As [7] stressed that the school experiences (either actively or vicariously) influence students' scientific attitude, the data shows that the thematic instruction seemed to be successful in doing so. Through the different activities and experiences provided through the thematic instruction, the students realized their different scientific attitudes.

Further, the data on Table 3 reveals that among the different scientific attitudes, it was active listening and curiosity that ranked the highest among the combined ranks between PT observations and student self-assessment scores. *Active listening* as defined in the literature is learning from other people by carefully listening to what others are saying and exerting effort to understand what is being said. Active listening is also a way of participating in a discussion and lobbying arguments if it is contradictory from one's point of view. In other words, active listening can be equated with active participation in class discussion.

On the other hand, *curiosity* is the desire to learn more about one's surroundings by asking questions investigating to find the answers. Simply put, curiosity is the attitude of wondering and asking questions about what is happening in one's environment. The definitions of scientific attitudes, active listening, and curiosity seemed to describe a common attribute--interest towards the science subject.

The literature review stressed that exposing students to a form of communication in the classroom can result in the development of certain attitudes [10]. In the present research, the thematic instruction seemed to have persuaded students to show interest in science by actively participating in the classroom and showing curiosity in the learning activities provided.

Aside from active listening and curiosity, the data in Table 3 show that high mean ranks appeared to cluster around scientific attitudes related to cognitive constructs: objectivity, critical thinking, creativity, and intellectual honesty. The clustering of scientific attitudes related to cognitive constructs was explained by [8] that scientific attitudes are actually 'habits of the mind' that students utilized as they embark on different scientific tasks. With the results shown, it can be inferred that the thematic instruction developed students' scientific attitudes with a stress on the cognitive-related attributes.

While it seems that the thematic instruction has improved the cognitive-related scientific attitude of students, results in Table 3 show that PTs and students seemed to agree that there is a need to provide activities where scientific attitudes such as independent thinking, taking initiative, perseverance, and assuming responsibility may be observed. The observations of PTs and experiences of the students were unanimous that the activities through the thematic instruction need to improve on providing students the avenue where they can manifest scientific attitudes on doing science investigations on their own and develop perseverance in the process. Based on how the thematic instruction was implemented, the researcher acknowledges that the time to implement the lessons was a challenge. Since the research needs to be implemented for a given time only, the activities were mostly time-bound, and the PTs were conscious of implementing activities under a time constraint. Nevertheless, the identified areas for improvement in promoting better scientific attitudes among students are noted by the researcher and will be discussed in the recommendations part of the paper.

CONCLUSION AND RECOMMENDATION

Based on the results of the study, it can be concluded that the thematic instruction implemented in this study promoted scientific attitude among students. The different activities implemented in class using thematic instruction primarily promotes active listening and curiosity among students. Also, the results of the study reveal that the thematic instruction implemented seemed to enhance more of the cognitive related scientific attitude skills.

In the conduct of the study, several limitations have been identified and are recommended for future research. First, the study includes only one group of students. Therefore, to validate further the results claimed in this study, it is suggested that the teaching method be conducted in quasi-experimental methods. Such is to determine if thematic instruction better promotes scientific attitude compared to other teaching strategies.

Another limitation cited is the time of delivery for the implementation of thematic instruction. Sincethe researchers conducted the study in a limited time, certain classroom activities were controlled. Perhaps, such a situation affected the observation that the thematic instruction implemented did not allow the enrichment of scientific attitudes that are related to the psychomotor skills. Therefore, for future research, it is recommended that the thematic instruction implemented in a period following natural classroom settings.

Implications to the Philippine K to 12 Science Curriculum Program

One of the main outcomes that the Philippine to 12 science curriculum aims to develop among its learners is the scientific attitude [13]. With the said outcome, the curriculum envisions learners to possess a scientific attitude that can guide solving problems, innovate a solution, and even make informed decisions.

The results of the present research seemed to support the vision of the Philippine to 12 science curricula. It can be inferred from the observations and even student self-assessment that they have developed the desired scientific attitudes through the designed thematic instruction. That said, the researchers encourage science educators to explore further its potential to effectively develop among students the scientific attitudes that the curriculum desires them to have.

More importantly, the results of the research imply that the delivery of the Philippine to 12 science curricula can also be modified to help it achieve its outcomes. Several kinds of literature cite that the present design of the Philippine to 12 science curriculum needs improvement for reasons such as coherence [14] and continuity [15]. In response, the present research seemed to address the said issues by offering a strategy that exposes students to a curriculum design that is not fragmented but integrates the competencies in themes that are relevant to their lives.

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