FOUR FILIPINO GRADE 8 TEACHERS' MENTAL CONSTRUCT OF THE INQUIRY-BASED APPROACH (IBA) IN TEACHING CELL DIVISION AND MENDELIAN GENETICS: A MULTI-CASE STUDY

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ABSTRACT

This study determined the four (4) Grade 8 science teachers' mental construct of IBA. Through interviews, classroom observations, and analysis of artifacts, the data were collected and analyzed using constant comparative analysis. Results reveal that IBA is a paradigm shift, student-centered, and motivational, and promotes higher order thinking skills. However, teachers also viewed the approach as resource and time consuming and requires good prior knowledge and skills of students. The identified mental constructs could be used as a guide on how an inquiry-based curriculum should be implemented. Since IBA has been found to be resource and time consuming, the trainings and seminars should focus on designing activities and creating instructional materials that maybe used easily in the classroom. The findings may also be used to design assessment instruments to measure teachers' inquiry-based science teaching competencies. Trainings on approaches to activate students' prior knowledge and skills are recommended, too.

Keywords: Constant Comparative Analysis, Mental Construct, Paradigm Shift, Perceptions, Student-Centered.

INTRODUCTION

The recent development in the Philippine education system is a big change under the K-12 program in the secondary education. The change in structure involves the lengthening of the years of education, adding two years to make it six years and having the junior and senior high schools. Based on the DepEd's basic curriculum guide, it is in Grade 3 where the practice of inquiry method of teaching starts. However, science typically receives very little time in primary classrooms, with teachers often lacking the confidence to engage in inquiry-based teaching because they do not have a sound understanding of science or its associated pedagogical approaches (DepEd, 2003). Moreover, students become less prone to ask questions as they move through the grade levels, listening instead and repeating the answers. This did not stop some government and private institutions from considering the inquiry approach as an important reform in the basic education. In fact, the use of the inquiry approach as a method developed toward 2006 when the Science Education Institute of the Department of Science and Technology (DOST-SEI), together with the University of the Philippines' National Institute for Science and Mathematics Education Development (UP NISMED) and the Philippine Council of Mathematics Teachers and Educators (MATHTED) published the frameworks of science and mathematics education in the country (Marchadesch, 2012). As indicated in its publication, there is still an emphasis on the development of inquiry skills. Toward the implementation of the K to 12 curriculum in 2016, the inquiry-based approach was retained as a new reform in understanding and applying scientific knowledge, performing scientific processes and skills, and developing and demonstrating scientific attitudes and values. There is a paucity of information as on how teachers perceive or construct the inquiry

approach as a teaching strategy and this study was therefore conceptualized to determine the Grade 8 teachers' mental construct of the inquiry approach.

LITERATURE REVIEW

Teaching Through IBA

It was Joseph Schwab (1960) who had an influential voice in establishing the view of science education through inquiry. He emphasized that teachers should present science as inquiry and that students should use inquiry to learn science subject matter. He added that the application of the inquiry approach involves the use of innovative activities such as laboratory activities or experiments to lead rather than to follow the classroom phase of science teaching. This means that students should "be inquisitive or curious first" before being introduced to the formal explanation of scientific concepts and principles. The importance of doing a laboratory work as an inquiry-based activity was demonstrated in the study of McDermott (2006) among physics teachers who recognized it as one that develops student's critical thinking and reasoning. With such result, inquiry could be defined as "a pedagogical method that combines hands-on activities with student-centered discussion and discovery of concepts" (Uno, 1990).

Inquiry instruction was also born out of the long-standing dialogue about the nature of learning and teaching. In particular, the work of Jean Piaget, Lev Vygotsky, and David Ausubel was blended into the philosophy of learning known as constructivism, which was then used to shape instructional materials (Minner et al., 2009). These constructivism-based materials are commonly classified under the inquiry approach. Such materials include hands-on activities to motivate and engage students while concretizing science concepts. According to the constructivist approach, there is emphasis that knowledge is constructed by an individual through active thinking. Active thinking is defined as selective attention, organization of information, and integration with or replacement of existing knowledge. Moreover, social interaction is necessary to create shared meaning. Therefore, an individual needs to be actively engaged both behaviorally and mentally in the learning process so that learning will take place. As constructivist approaches permeated much of the educational practice in the 1970s, it became particularly prominent in science education through the focus on inquiry. The term inquiry has figured prominently in science education, yet it refers to at least three distinct categories of activities - what scientists do (e.g., conducting investigations using scientific methods), how students learn (e.g., actively inquiring through thinking and doing into a phenomenon or problem, often mirroring the processes used by scientists), and a pedagogical approach that teachers employ (e.g., designing or using curricula that allow for extended investigations).

Mental Construct and Related Studies

Mental construct is something solely born and existing only in the mind. Examples are things that do not reflect what actually exists in the world such as abstract concepts; abstract images (i.e., do not correspond to what is concrete, merely a representation). It is a view, a way of viewing, a viewpoint, or an association, and a belief system. In this study, the mental construct of a teacher involves views on the inquiry approach, limitations on its use, benefits and decisions to use the inquiry approach. There are some studies on teachers' mental constructs or perceptions. For instance, Domjan (2003) conducted a study to describe elementary school teachers' perceptions of

science as inquiry in science instruction. Using constant comparative method to identify statements, perceptions, and impressions that occurred over time, the study involved 92 elementary school teachers teaching science in a large suburban district southwest of Houston, Texas. The study revealed the elementary school teachers' perceptions about inquiry as: mostly process skills, some conceptual knowledge, and very little affect with no perception of the nature of science. Not only perceptions, the study suggests that elementary teachers might benefit from increased and sustained professional development programs centered on inquiry teaching strategies. The author added that professional development activities on teaching science should be done as inquiry creates opportunities for teachers to confront and develop ways of thinking about inquiry and ultimately enhance inquiry-based teaching in their classrooms.

Ramnarain (2014) investigated the perceptions of physical sciences (physics and chemistry) teachers on the implementation of inquiry-based learning at a diversity of high schools in South Africa. The author found out that teachers at all locations of school have a positive perception of inquiry-based learning, with benefits for learners that include the development of experimental skills and making science more enjoyable. Eltanahy and Forawi (2019) explained science teachers' and students' perceptions about applying IBL in a private school in Dubai. Their findings revealed that teachers showed progress in applying inquiry instruction and students became more engaged in learning. In general, the authors reported that inquiry-based learning (IBL) represents the student-centered approach that focuses on encouraging learners to scientifically construct new knowledge. Moreover, Mujtaba et al. (2017), found out in their study that the responses from primary school teachers in England highlighted that inquiry-based learning was perceived to be easy to learn and apply. The teachers also perceived that their students reacted positively. Finally, in half the cases considered, teachers believed that inquiry-based learning facilitated engagement from girls within their classes.

To examine the perception of science teachers about the use of inquiry, Adofo (2017) conducted a qualitative study in Eastern Finland with seventeen participants including seven teachers from 6th to 9th grades and ten student teachers being trained to teach at 7th to 10th grade. Using email questionnaire and paper-based questionnaire, the findings showed that both teachers and student teachers shared similar views and overwhelmingly endorse on the use of inquiry in science. According to the author, inquiry-based teaching and learning has the potential to purposefully awake and sustain interest of students and promotes positive attitudes of students to learning science. IBA is also perceived that inquiry is a useful teaching and learning strategy to achieving learning outcomes as it promotes understanding of scientific concepts and enhances memory trace and active participation of learners in science lessons.

METHODOLOGY

Design of the Study and Case Selection

It is a multi-case design in which four (4) teachers were selected for an empirical investigation on their IBA practice through interviews and classroom observations. The participants were identified through the help of the science coordinator of the selected school. Each teacher was selected based on the length of teaching. Two (2) teachers were observed from each of the two selected target schools.

Data Collection and Analysis Procedures

Using an interview guide on a teacher's mental constructs, the teachers were interviewed separately. In the second meeting/interview, the information collected during the first meeting was validated. Observations were done for 10 days, and class sessions were video recorded. The researcher sought the teachers' consent before the videorecording of the classroom teaching. The data was collected prior to the pandemic lockdown in 2019. The data in the interview and classroom observations were subjected to constant comparative analysis for the identification of the emergent themes.

Data Validation

Member checking was employed to validate the data. First, the *verbatim* transcripts of the interviews and the interpretations in the form of assertions and supporting quotes were provided to all the cases for member check. Moreover, the findings were subjected to peer examination, in which the findings were given to a second reader for comments. Selected previously, the second reader verified the themes that emerged from the study.

RESULTS

The teachers' mental construct involves views and perceptions on the inquiry approach. Table 1a reveals teachers' mental constructs of IBA from interviews, while Table 1b reveals teachers' mental constructs of IBA from classroom observations.

Table 1a. Emergent Themes on the Teachers' Mental Construct of IBA from Interviews based on Constant Comparative Analysis of the Four (4) Teachers (Note: Color Coding of the Teachers – Teacher A, Teacher B, Teacher C and Teacher D)

Theme	Extracted Code	Description of Theme	Sample Response/Entry
IBA is a paradigm shift	Implementation using inquiry is a paradigm shift and it is institutional	Teacher's perception of IBA as a paradigm shift means from traditional to new approach	Unknowingly, I am doing the paradigm shift because I used to do lecture in all of my discussions. where she allowed her students to discover the characteristics of chromosomes that are undergoing a cell division through a laboratory activity instead of simply doing a lecture presentation
IBA is student-centered	Inquiry approach is student-centered.	Teacher's perception of IBA as student-centered focuses on the students as the key players	The students learn to explore more on their own and explore through their initiative The inquiry approach makes the students become inquisitive and curious, and they also learn reflective thinking I always want my students to do reflective discussion through analysis of illustrations, diagrams, models.
IBA focuses on the art of questioning	Inquiry approach is for the art of questioning	Teacher's perception of IBA focusing on the art of questioning means that the students are motivated to ask questions	The focus of the inquiry approach is the art of questioning. The inquiry approach is student-centered. She also said that "I believe I am always using the inquiry approach…
IBA promotes higher order thinking skills	Inquiry approach explores on student's initiative Inquiry approach makes curious and inquisitive students Teacher as facilitator develops student's critical thinking	Teacher's perception of IBA promoting higher order thinking skills is the main purpose of the new approach	The students learn to explore more on their own and explore through their initiative. I think students learn about cell division stages and solving problems in Mendelian genetics. Students learn to be very curious and inquisitive. The inquiry approach makes the students become inquisitive and curious, and they also learn reflective thinking. In using the inquiry approach, I think the teacher is the facilitator who should always ask critical questions where students learn to be very curious and inquisitive
IBA is motivational	Inquiry motivates learning and skills development	Teacher's perception of IBA as motivational means students' active learning	In doing an inquiry-based activity in the classroom, the students are motivated to learn.
IBA requires good prior knowledge and skills of student	Student's lack of content prevents doing inquiry in the classroom	Teacher's perception of IBA requiring good prior knowledge and skills of students lies on the role of the teacher	One limitation is characteristic of student. I have to consider the background knowledge of the students.
IBA requires more time and resources	Limited time for use of the inquiry approach Preparation is needed when inquiry is used Non-doing of experiment due to limited facility	Teacher's perception of IBA requiring more time and resources is one important limitation of the approach	Preparation and implementation are too long. Inquiry is useful but needs longer time to finish long and difficult activities. … the time is not enough to make the preparation. A lot of preparation is needed to be able to perform an inquiry-based activity. It is difficult for me to facilitate the discussion if I am not prepared. But it is not easy to do it. A preparation is needed. I cannot do that with my class because we do not have the facilities.
IBA is useful but with limitations	Inquiry is useful but not frequently used Inquiry-based activities in the module should be modified	Teacher's perception of IBA as useful but with limitations poses on the challenge to the teachers	A lot of preparation is needed to be able to perform an inquiry-based activity. … I still find IBT useful but I do not do it frequently. I know the activities in the Learner's module are inquiry-based but I need to have some modifications in the experiment/activities for better understanding of the students. A lot of preparation is needed to be able to perform an inquiry-based activity.

Table 1b. Emergent Themes on the Teachers' Mental Construct of IBA from Classroom Observations based on Constant Comparative Analysis of the Four (4) Teachers (Note: Color Coding of the Teachers – Teacher A, Teacher B, Teacher C and Teacher D)

Theme	Extracted Code	Description of Theme	Sample Response/Entry
IBA is a paradigm shift	Implementation using inquiry is a paradigm shift and it is institutional	Teacher's perception of IBA as a paradigm shift means from traditional to new approach	From lecture to using pictures and using the Smart TV From non-doing to conducting an experiment
IBA is student-centered	Inquiry approach is student-centered.	Teacher's perception of IBA as student-centered focuses on the students as the key players	usually divides her class into four (4) or five (5) groups depending on the number of students present to work on images of the stages of mitosis. She then allowed her students to work independently in answering the guide questions she prepared. The students conducted an experiment where they observed actual dividing cells The students had reflective discussion about the identify of an unknown picture of a cell. In a discussion that was student-centered, she never forgot to ask for questions or clarifications, solicit reactions or feedbacks, and inquire on misunderstandings or confusions.
IBA focuses on the art of questioning	Inquiry approach is for the art of questioning	Teacher's perception of IBA focusing on the art of questioning means that the students are motivated to ask questions	As Teacher Ces had emphasized, questions do not only gather information about the story. They also process the creative, reflective, and critical thinking skills of the students
IBA promotes higher order thinking skills	Inquiry approach explores on student's initiative	Teacher's perception of IBA promoting higher order thinking skills is the main purpose of the new approach	After the discussion, she asked the students to present their synthesis before the class and encouraged the other groups to ask questions about the presentations of their classmates.
	Inquiry approach makes curious and inquisitive students		Teacher Ace believed that asking these questions indicates that the approach has aroused students' curiosity and interest to learn. The group then identified the functions of these organelles based on the story. They discussed among themselves what they have identified and later reported them before the class. The challenge on the students on "*how traits are inherited*" made them use their thinking skills
	Teacher as facilitator develops student's critical thinking		She observed that her students had always something to ask during her classroom teaching transactions
IBA is motivational	Inquiry motivates learning and skills development	Teacher's perception of IBA as motivational means students' active learning	Use of personal experience to motivate the class Use of Smart TV to show picture of a chromosome to motivate the class Use of a story-telling activity to motivate the class Use of a video to motivate the class to motivate the class
IBA requires good prior knowledge and skills of student	Student's lack of content prevents doing inquiry in the classroom	Teacher's perception of IBA requiring good prior knowledge and skills of students lies on the role of the teacher	her students actively engaged in the discussion and even provided a variety of answers based on their experiences while taking a bath. It is here where she introduced the concepts of cell division. to enhance students' learning, she discussed with them human reproduction emphasizing the specific traits inherited from parents as a background information for her discussion in Mendelian genetics. had a review on the stages of mitosis using the Smart TV so that she could link this concept to meiosis Reviewing about the Law of Segregation and Law of Independent Assortment was necessary so that the knowledge learned can be applied in solving genetics problems.
IBA requires more time and resources	Limited time for use of the inquiry approach	Teacher's perception of IBA requiring more time and resources is one important limitation of the approach	had to search the net for a film on meiosis for the activity she planned for her regular class since they do not have the microscopes needed to observe the process. Aside from spending time to search for the right video clip, she also needs the time to show it to her class the process (cut-outs of mitosis stages) is tedious and time-consuming and requires several preparations recalled the long hours she allotted for the preparation of the materials and developing the implementation strategy since the activity should be done within the allotted time for the topic modified Activity 2 for more knowledge to learn about cell division
	Preparation is needed when inquiry is used Non-doing of experiment due to limited facility		Non-doing of an experiment.
IBA is useful but with limitations	Inquiry is useful but not frequently used Inquiry-based activities in the module should be modified	Teacher's perception of IBA as useful but with limitations poses challenge to the teachers	Though Act 1-5 are all inquiry-based activities, the students performed 2 activities only Repeating certain parts of the lesson also ate time so Teacher Des made adjustments by resorting to teacher-centered discussion.

DISCUSSION

IBA is a Paradigm Shift

Grade 8 Teachers considered IBA as a paradigm shift, where they have to change the focus of the teaching-learning process from them, as the key knowledge holders, to their students. They reported that currently they need to consider inquiry in their teaching of science, as Teacher Bes had indicated in the interview. According to her, IBA "*is a paradigm shift because we consider the inquiry approach in our science teaching which we have not done before."* The teacher reported that they (colleagues in the department) integrated inquiry-based activities in their current teaching-learning processes, which is by far, different from simply delivering a lecture as their former teaching strategy. Previously, Teacher Bes was just using the lecture method in teaching cell division and Mendelian Genetics. Under the new approach, she implements small group discussion or cooperative learning more often, as well as use a variety of learning materials in discussing about these topics. Teacher Ces also reported a similar change in her teaching approach, where she allowed her students to discover the characteristics of chromosomes undergoing cell division through a laboratory activity, instead of simply doing a lecture presentation. She now allows her students to observe a specimen under a microscope to be able to answer inquiry questions like "*In what way is one stage of mitosis you observe different from the other stage/s observed by the other groups*?" With a limited number of microscopes in their school, she divides her class into small groups to explore and discuss the answers to such a question. After her students reported their answers, she then supplements their knowledge with a clarification and correction of their misconceptions using their textbook.

In their actual teaching, while Teacher Bes showed a paradigm shift from lecture to using pictures and using the Smart TV, Teacher Ces maintained the conduct of an experiment about cell division. According to Blessigner et al. (2018), a paradigm shift is a radical change in the core concepts and practices of a given domain, discipline, or field. Paradigm shifts can occur at any of these levels and may cut across these levels. This change has been precipitated by unprecedented demand for high quality and meaningful education at all levels across the globe. As indicated in the teachers' responses which are consistent in their actual teaching, there has been a paradigm shift from traditional to more innovative teaching practices.

IBA is Student-Centered

The teachers also considered IBA as student-centered, where it allows students to explore the concepts of cell division and Mendelian genetics on their own. Student-centered has been repeatedly mentioned in the interview and has been associated with students' self-exploration of the concepts, which allows them to become inquisitive and reflective. Dividing the class into small groups and providing them with guide questions in studying the stages of mitosis through models and other forms of representations is a common practice among the teachers and is perceived to be a student-centered learning environment. In Teacher Bes' actual teaching, student-centered environment was established during small group discussion, like the group activity on mitosis where she reported dividing her class into four (4) or five (5) groups, depending on the number of students present to work on the images of the stages of mitosis. She then allowed her students to work independently in answering the guide questions she prepared. She gave them time to discuss among themselves their answers to the questions. The group then chose a reporter who presented

their answers to the whole class. At the end of the presentation, she then synthesized the points raised by the reporters and corrected the misconceptions presented. In another instance, she gave opportunity for the students to help each other in answering board work during the conduct of the problem-solving activities in genetics and Activity 4. Although aside from this circumstance, Teacher Bes created rather a passive, teacher-centered environment even when she combined her lecture with technology; passive, since students were silent during recitation but noisy during discussion; and teacher-centered, since Teacher Bes opted to discuss the entire lesson through the traditional lecture style method, because the class was not participating or sharing any of their ideas. Nevertheless, classroom technique specifically, cooperative learning, at least created a student-centered environment.

Teacher Ces believes that as the students learn to conduct an experiment that is inquiry-based, the students become inquisitive, curious, and reflective thinkers. In her actual teaching, she was able to create and sustain a student-centered environment during the entire observation period. Her enthusiasm and apparent concern for the well-being of her students influenced their rate of motivation to learn. Starting from the recall part about cell organelles in Day 1, she already established rapport with her students by asking questions they can easily understand and answer. She combined it with fitting praises and enjoyable interaction with her modulated voice to capture the attention of the students. A very good point went to Teacher Ces for performing an experiment in her class – something that the other three (3) teachers were not able to do. By preparing a slide of an onion root tip, the students were able to see a live demonstration of mitosis in action. Thus, specific classroom techniques employed by Teacher Ces created a student-centered environment. Her group activity about "Smart Workers of the Company", the story of the cell parts working in a factory got the students engaged with the lesson, as they shared their own inputs and got into discussion with their classmates. The only thing Teacher Ces did in this activity was to ask questions and clarify the misconceptions of some students. Everything else - description, analysis, and reflection- was done entirely by the class. Moreover, the small group discussion on the stages of mitosis allowed the students to summarize main ideas and analyze the concepts. In small groups, the role of each *student* is to help other *students* to develop their own ideas. Sometimes coupled with videos, the cooperative learning employed by Teacher Ces allowed students to respond to what they have seen and to conduct a group analysis on the main ideas of presentations.

Moreover, Teacher Ces used some forms of representation that made students' learning student-centered. For example, in the discussion of the stages of mitosis where she played a video, Teacher Ces constantly checked if the students understood what they are seeing and occasionally dropped facts. After the video, she asked the class to describe each stage of mitosis and dared other students who did not recite to react to the answers. Further, she used other forms of representation, such as pictures, personal illustrations, and visual aids in textual form about cell division and Mendelian genetics. As the students discussed the specific topic on their own in small groups, learning became student-centered. The problem-solving activities in Activity 2, 3, 4 and 5, which the students conducted, developed their problem-solving skills where they integrated the theory of inheritance with practice and applied knowledge to solve particular problems. Such student-centered activities created a better learning experience among the students. More problem-solving exercises in genetics were done by the students, which took a student-centric approach. Her incorporation of a worksheet ("Bikini Bottom Genetics"), which was not part of the LM, was student-centered as the students analyzed and solved problems in genetics. The completion of problem-solving exercises

allowed for a better understanding of the processes involved as well as the outcomes obtained. Another method she used was a role-playing activity as a springboard for the discussion of genetics. In this activity, a selected student acted as Gregor Mendel as he answered questions thrown by Teacher Ces during the presentation. Apparently, this had also been her method of checking if the students were reading their learning modules or not. Similarly, Teacher Des reported that she uses cooperative learning as a form of student-centered learning approach. In her case, she allows her students to analyze illustrations, diagrams, or models of cell division, discuss them, and come up with concepts that describe the stages of the process. She considered the approach as effective where students can talk about concepts and come up with good points or ideas.

In her actual teaching, the student-centered environment was established as Teacher Des asked the students to go to the front to explain inheritance of traits in their family using a family picture. This motivational activity created a classroom where the students shared opinions, insights, ideas and own interpretation. Teacher Des focused on individual learning through this sharing, as she also acknowledged each student's insights, as she related them to the topic. This activity created a better learning experience among the students. Cooperative learning was also used by Teacher Des to create a student-centered environment. Coupled with a video presentation, the small group discussion on the stages of mitosis involved Teacher Des' asking "*Why*?" and *"What do you think?",* which were enough to encourage students to deepen their understanding of the concept. Moreover, Teacher Des asked the students to perform in small group discussion Activity 4 and 5, while Activity 3 was done individually. In these problem-solving activities, learners get to think "out of the box", looking for the correct solution, which involved communicating with group members while discussing a particular solution. This happened during the small group discussion when they discussed the solution to the genetics exercise. More group problem-solving exercises were done by the students, which made the student discuss and solve on their own. In one of the presentations, when someone answered wrongly, she gave the class the liberty to correct him/ her or state their suggestions before giving the final answer.

Though Teacher Ace did not mention the student-centered nature of IBA in the interview, this was observed in her actual teaching. In a discussion that was student-centered, she never forgot to ask for questions or clarifications, solicit reactions or feedbacks, and inquire on misunderstandings or confusions. The students were quite comfortable with Teacher Ace; the only downside was them sometimes being too noisy in class. By frequently doing group discussions and sharing, Teacher Ace promoted class interaction and let the students take the limelight in presenting what they have learned about the lesson. For example, she asked the class to divide themselves into five (5) groups for a small group discussion on the stages of mitosis based on a model of mitosis. After 20 minutes of discussing, exchanging thoughts, and sharing opinions, a presentation took place with one student-representative in front. This student-centered activity allowed the students to come up with their own description of the characteristics of each stage of mitosis based on the given model. Another student-centered activity was Activity 2, which the students conducted to discuss how they could compare mitosis with meiosis in terms of four (4) characteristics. Just like the previous activity, the representative posted and presented the group's output on the board. This activity served as the continuation of the first activity that used a model where the students, on their own, worked on the differences between mitosis and meiosis. With a student-centered environment, the students can work independently. Similarly, the student-centered environment was evident as the

students performed individually Activity 4 and Activity 5 of the LM. In these activities, guided by the knowledge created using the model of mitosis, the students learned using thinking strategies. Likewise, more problem-solving activities involving monohybrid and dihybrid crosses created a student-centered environment because the students analyzed the problems independently. Teacher Ace's construct of inquiry as student-centered must be because she made use of forms of representations in her discussion. For example, when she discussed mitosis, she used the model as she asked inquiry-based questions such as "*how do you describe the chromosomes in mitosis? and based on this model, in your own words, how do you define mitosis?*' Asking these questions made the students think critically and participate actively during the discussion, as the students were able to give their description of the chromosome. A student-centered environment was also observed in Teacher Ace's discussion of Mendel's experiment through a personal illustration. As she asked some inquiry-based questions, the students did specific thinking skills such as providing own examples to differentiate important genetic concepts. The focus of instruction were the students because instead of Teacher Ace, they were the ones who explained the answers to her questions. It could be noted, however, that the student-centered nature of the discussion was made possible through Teacher Ace's explanation of the experiment.

All these accounts of the teachers are consistent with what Bransford et al. (2000) had indicated, that by placing students at the center of instruction, there is a promotion of a learning environment more amenable to the development necessary for students to become independent and critical thinkers. The authors added that a student-centered learning is an environment that moves students from passive receivers of information to active participants in their own discovery process. Although such practice achieves certain levels of student-centeredness like student cooperation, interaction, and reflection (Zeki & Sonyel, 2014), it fails to fully develop self-regulation and autonomy. The teachers still have certain dominance over the learning process of the students. According to Paris and Combs (2006), the teacher and students in a student-centered learning environment are co-participants in the learning process, while the teacher strives toward intense student engagement with the curriculum. Teacher's dominance may forfeit the student-centeredness in the learning process and reduce co-participation. Nonetheless, the use of small group discussion has effectively exchanged ideas among the students, which may have developed students' academic and social skills as evidenced by their participation and presentation (Zeki & Sonyel, 2014). Gorzycki (2010) supports that in small group discussions, the students are engaged in analyses, evaluations, problem-solving, and processing information. Moreover, the use of forms of representations and problem-solving activities likewise create a student-centered environment. As the teachers reported, while the students are able to talk in the small group discussion and are able to come up with good points or ideas, the use of representations during discussion of concepts as well as doing problem-solving activities involve active learning, in which students solve problems, answer questions, discuss, explain, debate, or brainstorm during class (Dochy et al., 2003).

IBA Promotes Higher Order Thinking Skills and Focuses on Art of Questioning

IBA has also been considered as an approach that develops higher order thinking skills of the students. The teachers looked at it as a teaching strategy that promotes the art of questioning, which in turn, allows the development of students' critical, reflective, problem-solving skills, as well as inquisitiveness and curiosity. As Teacher Ces had indicated during the interview, the "*focus of the*

inquiry approach is the art of questioning; the inquiry approach makes the students become inquisitive and curious, and they also learn reflective thinking." According to her, it facilitates the asking of questions in the classroom although it is usually the teacher who initiates the asking or encouragement for them to ask questions; as Teacher Ace had also indicated, "*I encourage them to react by asking questions during presentations of output. I tell them they can ask any question that will require them to think critically*." In her classroom, Teacher Ces used a story-telling approach in discussing the functions of the different cell organelles. The story is about the complaint of a group of organelles as "company workers "(mitochondria, lysosomes, ribosomes, Golgi bodies, and endoplasmic reticulum) who claimed that while their work is very tiring and routinary, the work of the other group of organelles (cell membrane, cell wall and chloroplast) is very light. To clarify the complaint, in an emergency meeting, the nucleus as the "head of the company" gives the workers a chance to defend their side. She divided her class into small groups where she distributed a copy of the story and a list of guide questions. The group then identified the functions of these organelles based on the story. They discussed among themselves that they have identified and later reported them before the class.

As Teacher Ces had emphasized, these questions do not only gather information about the story. They also process the creative, reflective, and critical thinking skills of the students as well as inquisitiveness and curiosity (Minigan, 2017; Cuccio-Schirripa & Steiner, 2000). She believes that as the students answer the questions, it develops their thinking and reflective skills as they connect the story with the roles of the organelles in cellular processes and even imagine themselves taking the roles of these organelles. It allows them to analyze and make judgment about what has happened (Porntaweekul et al., 2013) in the story vis-à-vis the functions of the organelles in the process of cell division. Moreover, the questions allowed them to analyze if their understanding of the story is right or help them evaluate if what they learned about the roles of the organelles is correct and consistent with what the literature is teaching. The story-telling activity prepared by Teacher Ces seemed to be the best activity for making an inquiry environment because of the way the questions were asked (why, how, in what way, if you had a chance…). The questions in the activity were open-ended, which were carefully prepared in advance by Teacher Ces. According to Clayton (2012), when questioning, teachers should focus on posing open-ended questions of a consistent quality that allow students time to reflect and respond. To engage students meaningfully, questions should be prepared in advance. By doing so, teachers are able to wrestle with the essential to know content and ensure that questions are purposeful and aligned with the instructional goals for the lesson."

On the other hand, Teacher Bes believes that IBA promotes the development of students' higher order thinking skills because it allows them to synthesize their ideas after exploring independently and discussing among themselves the concepts of cell divisions and Mendelian genetics. In her actual teaching, Teacher Bes used cooperative learning as an approach in teaching cell division and Mendelian genetics. She allowed her students to discuss the answers to the inquiry questions that she gave them. After the discussion, she asked the students to present their synthesis before the class and encouraged the other groups to ask questions about the presentations of their classmates. Although she added some inputs into the discussion and corrected their misconceptions, the entire activity has allowed students to evaluate independently certain ideas from their peers and thereby initiating a certain level of independence in the learning process. According to Leaders (2020), the ability to initiate independent learning is an important higher

order thinking skill, just like flexibility, leadership, productivity, and social skills. Moreover, opportunities for testing reflective skills among the students still arose in Teacher Bes' discussion of the reasons why the pea plant was used in Mendel's experiment and her doing of problem-solving activities in small group discussions. Not only did this promote interaction, but it also triggered the curiosity and inquisitiveness of the students. In addition, the students' investigative skills were put into test when they were doing board work since they would always be asked if they were sure about their answers. As observed, problem-solving activities and small group discussion employed by Teacher Bes promoted both the reflective and investigative skills of the students because they were made to solve and analyze problems in genetics. Meanwhile, Teacher Ace considered IBA as an approach that supports the development of students' curiosity and inquisitiveness, which she believes could contribute to the development of their higher order thinking skills. According to her, "*students learn to be very curious and inquisitive.*" She observed that her students had always something to ask during her classroom teaching transactions. Although she has no available data to prove her claim during the interview, she believes that such behavior indicates the development of students' higher order thinking skills. In her actual teaching, she believed that students were able to critically analyze the information presented to them during the study session. According to Leaders (2020), where students start crafting their own questions or strategizing their inquiry, higher order thinking skill is developing. Yung (2020) had also purported that curiosity or being inquisitive is an important higher order thinking skill that could lead to an active and meaningful learning. Through asking questions, students could fill the knowledge gaps during a study session.

Teacher Ace believed that asking these questions indicates that the approach has aroused students' curiosity and interest to learn. If this has not been the case, they would not be able to ask questions with an open mind (Salmons, 2016). This is important because curiosity could help them remember lessons that might have otherwise gone into one ear and out the other (Stenger, 2014). Likewise, it could enhance their love for learning (Mathis, 2015); hence, making their learning experience very pleasurable (Stenger, 2014). Nonetheless, Teacher Ace had indicated that the teacher will remain the facilitator for the development of students' curiosity and learning.

Moreover, asking the students about their own traits that could be related to their parents' traits promoted reflective and investigative skills. Likewise, asking of inquiry-based questions using the model enhanced the skill of reflection and investigation since the students were stimulated to think as well as define mitosis in their own words. She promoted critical thinking among her students by asking questions catering to the higher order thinking skills, like the differences between mitosis and meiosis and the reasons why pea plants were chosen by Mendel for his experiment. In every discussion, Teacher Ace made it a point to ask the class about the relevance of studying mitosis and meiosis and explain their application to our everyday lives. Problem-solving activities (Activity 2, 4, 5 and other activities) were also done frequently, either by group or individual.

IBA is Motivational

Teachers also perceived IBA as an approach that motivates students to learn, as Teacher Des reported "*doing an inquiry-based activity in the classroom had motivated my students to learn."* She believes that any inquiry-based activity that is presented to the students makes them motivated to learn the concepts taught to them. For instance, she observed that students had become more

attentive and engaged when she used the sharing of personal experience as part of her strategy in teaching heredity in Mendelian Genetics. The activity was part of her inquiry-based teaching strategy, where she asked the students to observe their family picture and identify the traits they and their siblings have inherited from their parents. According to her, students' attention was aroused through the activity, and they became more interested to listen to their classmates' personal stories during the discussion. Bravo (2015) indicated that the use of personal stories increases the students' engagement in the learning process, and it avoids making students feel inadequate or not knowing anything about the topic. Similarly, Kane (2013) reported that motivating students in an inquiry-based learning could result in increased student participation as well as student achievement and retention. Teacher Des reported that her "*students were motivated to solve word problem in Mendelian Genetics"* through the activity. Teacher Des used media like educational videos as springboards for the discussion. Since the answers to her questions can be found in the videos, the students were very attentive in watching. The motivational activities, showing a video clip about the DNA, identity of a cell and bringing a family picture, made the students participate and interact actively. In the case of video presentation, Lands (2011) supports the use of this in classroom discussion because it can engage students, spark a conversation, and bring lessons to life. Communication using video is also powerful and exciting to discuss lessons in science. Her resourcefulness could be noted, as she added more bases for comparing mitosis with meiosis. When nobody wanted to identify the other characteristics used by Mendel, using the LM, one student was motivated to answer. To add, Teacher Des really appeared comfortable when teaching, showing her mastery of the content she was discussing. This must have been observed also by the class which made them more eager to listen to what she was saying.

The rest of the teachers (Ace, Bes and Ces) did not mention about this construct of IBA in the interview, but this construct was observed otherwise in their actual teaching. For example, Teacher Ace used a similar approach, i.e. connecting the lesson with her students' realities, in discussing cell division and observing similar outcomes. In her case, she connected cell division with the students taking a bath every morning, where dead cells are peeled off and replaced with new ones through mitosis. She reported that in so doing, students learn to connect mitotic cell division with how their body maintains its health and protection against external forces. According to her, the students "*understand that body cells need to divide for growth, survival and replenish old tissues, which are important in maintaining good body condition."* This could possibly support what Napitupulu and Munanadar (2017) had observed that when lessons are connected to students' real-life situations, they could easily acquire the knowledge taught to them. Hence, Teacher Ace is confident that her students obtained the "*knowledge of cell division and the various events that occur in each stage of the process.*" The success of the inquiry approach relies heavily on the inquirer. Thus, the teacher must have the ability to catch the attention of her students and sustain it throughout the class period. Teacher Ace achieved this using vocalics, or the variation on the loudness and softness of her voice while discussing. She also posed questions that were easily relatable to the students, like when she asked them about the science behind regularly taking a bath or the reason why we share a lot of similarities with our parents. It is also important to note that Teacher Ace was very persistent in soliciting responses from her class- a characteristic which is highly valued for the inquiry approach. It was also observed how reluctant the students were at the beginning of the class, since this new method of inquiry is something, they were not quite used to. But through constant motivation, Teacher Ace was able to make the students answer comfortably and correct them should there be any mistake or misconception in their responses. For example,

when the answers to Activity 2 were solved on the board, two (2) groups were worried to go to the board but with motivation, they posted their answers in front. Another example involved a board work on determining the seven (7) contrasting traits used by Mendel; some volunteers were asked to correct/check the groups' answers posted on the board. The fill-in-the-blank visual aid posted on the board containing questions about the dihybrid cross motivated the students to participate in the discussion. Although she did it too late, calling inactive students to recite and not only those who were raising their hands was a very good practice to keep the energy alive inside the classroom. Representation in the form of interactive visual aids in textual form and problem-solving exercises also motivated the students to participate and learn.

Most often, during the recall part of her lesson, Teacher Bes always reminded the students to refer to their LM since nobody was able to answer her questions. By immediately giving the answer without motivating the class to think deeper, Teacher Bes managed to allot more time for her discussion. One possible factor why the students were not able to answer her queries, aside from lack of knowledge about the content, might be her soft voice, which did not help much to motivate her students to answer. Although Teacher Bes followed an inquiry instruction that is structured inquiry, in which the teacher provided the students with hands-on problem to solve, it is assumed she did not have the complete passion at all to do the inquiry approach in her classroom. This was apparently seen in the manner of her questioning, wherein instead of starting to ask the students to describe the chromosomes, she proceeded right away in asking its function. However, eventually, she managed to urge the students to answer and participate, like when she asked for the difference between mitosis and meiosis and one student bravely answered. Another instance was her motivation for the students to go to the board to answer an exercise about the concept of the recessive trait, dominant trait, homozygous trait, heterozygous trait, genotype, phenotype, P and F_1 based on the cross of the seven (7) characteristics used by Gregor. Though the observation of Teacher Bes' teaching, motivation was too minimal; these observations prove that the inquiry approach is motivational.

Teacher Ces had a consistent level of energy and enthusiasm which evidently influenced the vibe of the students, making them very receptive to the new lesson. It was also noticeable how she used praises from time to time whenever somebody answered. This indeed motivated other student to answer also. She was also very persistent in encouraging the students to discuss in front, after group activities. There were also ice-breaker acts from each group to serve as a breather from the technical lessons being discussed. Although some were still shy and did not dare to recite, Teacher Ces made sure to ask if they are still following through the discussion and if not, repeats it before shifting to another topic. The students' performance in the two motivational activities on cell division and Mendelian genetics motivated the students to do critical thinking, react, participate, and interact. Also, the students in small groups were motivated to illustrate the stages of mitosis. There were spontaneous answers of the students with regard to the characteristics of the stages of mitosis. With Teacher Ces' motivational voice and dynamic teaching, the students were motivated to recite and participate. All these observations prove that the inquiry approach is motivational.
Motivation plays a crucial role in learning. Inquiry approach is a motivational means that in an inquiry environment, the teacher is able to energize and direct the behavior of the students toward specific goals. As the teacher motivates the students in different ways, the students acquire knowledge, increase initiation, persist in activities, improve achievement, and develop a sense of discipline (Napitupulu & Munanadar, 2017).

IBA Requires Good Prior Knowledge of Students

In the implementation of IBA, the teachers observed that the approach requires students' good prior knowledge and skills to make it effective, and to create a productive learning experience. Teachers Des and Ace, for instance, indicated in the interview that they have difficulty implementing the approach with students who lack a prior knowledge of the topic. Teacher Des commented that "*I have to consider the background knowledge of the students; if the student does not have the basic background, use of the inquiry approach is not effective."* Thus, she always makes sure that she connects her discussion to a real-life experience of the students. Connecting the lesson to real-life situations could somehow assure that students have the prior experience needed for a productive use of the approach. For instance, when introducing the concept of Mendelian genetics, she asks her students what traits they inherited from their parents.

She believed that by doing this approach, she is able to initiate students' interest to learn. Likewise, to enhance students' learning, she discusses with them human reproduction, emphasizing the specific traits inherited from parents as a background information for her discussion on Mendelian genetics. Both information, i.e., the observed traits inherited by the students from their parents and the discussion on human reproduction, now serve as the students' prior knowledge, which she believed has effectively facilitated students' learning with IBA. She reported that when students' prior knowledge is inappropriate or inaccurate, it hinders learning. But having the accurate and appropriate background information, students become more interactive, and the session become more productive. Students learn more readily with IBA when provided with the appropriate prior knowledge. Olagoke et al. (2014) reported similar observations and concluded that inquiry-based teaching is more effective when the students already have a strong knowledge of the subject matter at hand. Ambrose et al. (2010) had also indicated that students learn more readily when they can connect what they are learning to what they already know. According to Hailikari et al. (2008), the importance of prior knowledge on IBA is to ensure that the teacher's expectations of what students should learn is consistent with the students' actual knowledge gained. Inaccurate knowledge usually leads to misconceptions (David, 2017) and distortion of the students' view of the new information presented to them (Via, 2016).

On the other hand, Teacher Ace reported that students' motivation to engage in IBA depends on the level of students' knowledge of the topic. She commented that "*one limitation is characteristic of students; if the students lack knowledge about the topic, they are not motivated to do inquiry-based activities."* With this observation, she also connects her lesson in cell division with the students' real-life experiences, such as taking a bath as earlier discussed. She believed that such reality readily presents the essence of cell division as a process that replaces worn out tissues in the body. Doing it could arouse the interest of her students to actively participate in the discussion. In fact, she reported that when she asks questions related to taking a bath, her students actively engage in the discussion and even provides a variety of answers based on their experiences while taking a bath. It is here where she introduced the concepts of cell division. As indicated also in her interview response, Teacher Ace uses the answers of her students as her springboard for discussing cell division. She supplements the prior knowledge of her students with the concepts that she needs to introduce to them. Diaz (2017) had considered prior knowledge gained from an experience as "the mesh that would connect, link, relate, and associate to new information." However, he indicated that such knowledge should be "reconstructed into a new and improved knowledge." In

her actual teaching, Teacher Ace made sure that prior to discussing a new topic, she conducted a short review about the past lesson. This approach of making a review activates the students' prior knowledge. During the recall phase, majority of the class participated, hence Teacher Ace was able to clarify ideas and answer questions from the students. Yet, it was observed that when it was time to ask the students any idea about the current lesson, the class went silent. Some had ideas but were afraid to raise their hand because of uncertainty, while majority had no idea at all and did not raise their hands simply because they did not know the answer, indicating the students' lack of prior knowledge. These situations not only consumed time, but tested Teacher Ace's ability to encourage her class to speak up. Over time, one by one, the students started to answer, although there were responses the teacher wanted to have but could not get, since her students lacked the background knowledge about some topics in cell division and Mendelian genetics. Specifically, Teacher Ace had a review on cell parts so that the nucleus' function could be linked to the DNA and chromosome. Another example was a review on the cell parts so that this knowledge could be linked to the important role of the nucleus. Moreover, Teacher Ace had a review on the stages of mitosis so that it could be linked to the role of mitosis. In so doing, learning the new lesson was stimulated. The last example was the review on the concept of homozygous and heterozygous traits, P, F_1/F_2, dominant/recessive traits, genotype/phenotype so that such knowledge could be linked to monohybrid and dihybrid crosses.

Meanwhile, for the skills, Teacher Des meant it to be something about the skills learned by the students in an inquiry environment, as she said, "*I do not want the spoon-feeding mechanisms because the students will not become curious; this is the reason why I still decide to use it because the students are motivated to learn."* Chhem (2000) stressed the disadvantages of spoon-feeding that can do harm to the students. First, spoon-feeding does not stimulate active participation from the students and only fosters rote learning. Second, spoon-feeding does not promote independent learning and creativity. Finally, students lack initiative and problem-solving skills because they have not been trained to search for data by themselves. It was good that in Teacher Des' actual teaching, she asked the students to solve problems in genetics through cooperative learning to overcome spoon-feeding (Samah et al., 2009). It was also evident that Teacher Des had a good grasp of the art of questioning, as she was able to ask questions which motivated the students to answer. She checked if students could still follow her discussion; asked the opinion of the class in certain issues, like the effect of errors during meiosis; and guided students toward understanding by simple inquiries. Understanding concepts through the inquiry approach requires a student's prior knowledge. Specifically, Teacher Des had to make sure that the chromosome and cell cycle were completely understood so that she could link these to mitosis. In so doing, mitosis properly discussed inquiries. Another example involved asking the students' background knowledge on mitosis so that Teacher Des could link it to meiosis. Moreover, the knowledge on gamete formation was linked to the Law of Segregation, which was further understood because an illustration was made by Teacher Des on the board. Often, she also repeated what she tackled, just to make sure that everybody understood the concept. The hand activity on the stages of mitosis was also used to activate the students' prior knowledge. All these observations prove that the inquiry approach requires a student's prior knowledge. To enhance students' learning, she discussed with them human reproduction, emphasizing the specific traits inherited from parents as a background information for her discussion in Mendelian genetics.

Meanwhile, most of the questions posted by Teacher Ces during recall and abstraction were answered by the students; however, there were still instances when the class would go silent. Despite her reminder to peruse the LM prior to class discussion, most still did not have the initiative to read in advance. This led to the extension of the time for recall and discussion since Teacher Ces always tried to modify her questions just to solicit a response. But when nobody really talked, she was pushed to give the answer to her own question, which is something that must be avoided as much as possible. However, over time, it was observed that the students became more comfortable in answering Teacher Ces' questions since most of these inquiries were based on describing, comparing then defining the concepts. For example, Teacher Ces had to ask the students about the chromosomes in each stage of mitosis so that the students' knowledge on this could be applied to the topic in the new lesson (chromosome behavior in each stage of mitosis). Reviewing about the Law of Segregation and Law of Independent Assortment was necessary so that the knowledge learned can be applied in solving genetics problems. The hand activity on the stages of mitosis was also used to activate the students' prior knowledge. True enough, the inquiry approach requires a strong student's knowledge.

According to Donovan and Bransford (2005), students come into the classroom with preconceptions about how the world works. If their initial understanding is not engaged, they may fail to grasp the new concept. Many of the students' everyday experiences create misconceptions about specific concepts in science. Thus, the students' prior knowledge in the understanding of the concepts must be addressed in order to evoke a conceptual change. Olagoke et al. (2014) added that inquiry-based teaching is more effective when the students already have a strong knowledge on the subject matter at hand. While this is true, teachers should not stop from using the inquiry method with those students who do not have prior knowledge or have not yet gained "internal guidance. Teachers activate the students' prior knowledge by creating activities, such as motivational activities, interactive lecture, brainstorming and practical activities that build relevant background knowledge (Keene & Zimmerman, 1997). Lewis et al. (2010) opined those illustrations or drawings can also be used to activate prior knowledge.

IBA Is Time- And Resource-Consuming

Although the teachers provided the above positive perceptions on IBA, they also reported some limitations of the approach, one of which is time- and resource-consuming. All of them reported that they need to spend more time preparing and implementing the inquiry lessons and activities. Aside from time constraint, IBA is also resource-deficit. Teachers need to be innovative or creative to be able to develop inquiry-based activities as Teacher Bes had indicated during the interview "*If there are activities that are not very clear, we look for other activities or we modify the activities."* Although the modules indicate the activities to be done for the topics of cell division and Mendelian genetics, their school lacks the resources for some of the activities. Teacher Bes pointed this out during the interview, to wit: "*In the module, there is one experiment in mitosis; I cannot do that with my class because we do not have the facilities; The microscopes are not working properly so I cannot motivate my students to do it."* Teacher Des also commented that "*I know the activities in the Learner's module are inquiry-based but I need to have some modifications in the experiment/activities for better understanding of the students."* Hence, they need to search for alternative activities to deliver the necessary learning to the students. For instance, Teacher Ace had to search the net for a film on meiosis, for the activity she planned for

her regular class, since they do not have the microscopes needed to observe the process. Aside from spending time to search for the right video clip, she also needed the time to show it to her class. Unfortunately, they lack the necessary time during class hours. Thus, she had it shown in one of the vacant periods of the students. As such, she commented that "*preparation and implementation are too long in using the IBL*." As much as how inquiry approach sounds promising, it is time-consuming. There were also times that Teacher Ace did not finish her lesson. There were also episodes on quite a slow-paced discussion flow, since the teacher continuously asked questions, which took a long time to be answered by the students, like her method of questioning about mitosis, meiosis and dihybrid cross. The reluctance of the students to answer consumed more time than usual. Also, a lot of times, the students did not comprehend the explanation behind the concepts (like in Independent Assortment), so Teacher Ace often repeated her discussion. Furthermore, the time it took to solve problems on the board during the discussion of the Principle of Dominance took longer than expected, since the concept was not clearly understood by those who answered. The same scenario happened also in doing the dihybrid cross, which was repeated numerous times. It was also observed that out of the five (5) activities in the LM, only three (3) activities were performed by the students. These observations prove that the inquiry approach is time-consuming; longer time is needed for the preparation and implementation. Teacher Ace really tried to do the inquiry approach throughout the 10-day discussion of cell division and Mendelian genetics, but the time was not enough to do it completely. However, the number of instances where the time was found to be limited does not imply poor teaching and poor PCK of Teacher Ace. The instances served as evidence to prove that the inquiry approach is truly time-consuming.

In her actual teaching, Teacher Des also experienced the problem of lack of time to finish the content scheduled to be discussed. Since soliciting answers from the class took a longer time than usual, the range of content was narrowed down to fit into the remaining time. It might be the reason why she often went straight to discussing the main lesson instead of asking the students to define the terms or describe what happens in such processes like meiosis and mitosis. Repeating certain parts of the lesson also took up a lot of time, so Teacher Des made adjustments by resorting to teacher-centered discussion. Lack of time was also the reason why she resorted to asking the students to answer Activity 3 and Activity 5 as assignments though Activity 2 and Activity 4 were done in the classroom. The few observations on Teacher Des' teaching show the lack of time that may indicate that Teacher Des preferred to discuss everything on her own, resulting in almost a complete discussion, although the content may suffer, and students would become less exposed to the inquiry approach. Nevertheless, these observations prove that the inquiry approach is time-consuming.

Teacher Ces reported similar experiences during the interview. She narrated to have done a lot of preparations to be able to come up with the story-telling activity for cell division. She recalled the long hours allotted for the preparation of the materials and developing the implementation strategy since the activity should be done within the allotted time for the topic. She needed to time her discussion and the implementation of the activity to ensure that everything will be done within the study session. There were only few observations on Teacher Ces' teaching showing lack of time. Every activity she used took 20 minutes or longer, excluding analysis and synthesis. However, it can be said that the time was well-consumed for each meeting. The time it took to engage the students to the topic was short, so the bulk of the time was allotted to performing Activity and

Abstraction of the 4As. When she prepared visual aids to discuss meiosis, since the visual aid was loaded with too much information, she decided to just read the information without further explanation and clarification. There were also instances when Teacher Ces was not able to wrap up the lesson and evaluate her students, so she postponed it for the next meeting. The students were able to perform all the activities in the LM in the classroom. Activity 3 and Activity 5 were given by Teacher Ces as an assignment. Nonetheless, such instances on Teacher Ces' teaching prove that the inquiry approach is time-consuming.

In the case of Teacher Bes, she had to cut out pictures of mitosis in doing an activity related to cell division. She found this important to maintain her students' interest in learning about mitosis, albeit the tedious and time-consuming process that requires several preparations (e.g. looking for the appropriate pictures, cutting them out, planning how they would be implemented, etc.). Nonetheless, she did this so that "*students will have a very clear understanding of the concepts of cell division."* She believes that she needs to scaffold the learning of the students with this activity to help and guide them achieve their learning goals. Jamal and Shah (2015) had indicated that scaffolding is helpful in guiding students interact with the lesson, materials, and their peers. Scaffolding activities require teachers to restructure their learning activities or use alternative activities. Teacher Bes discussed the lessons in a fast-paced manner, but still she often did not finish the lesson before the class ended. This might be attributed to the time allotment for the activities and discussions. A huge chunk of class time was dedicated for doing the activities in the LM and combined with unnecessary noise and disorder; the time got prolonged than necessary. There were also no closure or wrap-ups before dismissal nor simple evaluation or synthesis. Although Activities 1-5 are all inquiry-based activities, the students performed two (2) activities only - Activity 2 and Activity 4, which could be due to lack of time and facility. It can be noted that Teacher Bes guided the students on how to answer some problems in monohybrid cross and dihybrid cross to maximize the time for the class. Time was also the element why Teacher Bes missed the Activity and Analysis components of the 4As. Missing these components implies that Teacher Bes also missed some important concepts of cell division and Mendelian genetics. The effect would be shortchanging the content knowledge of the students.

Hooley (2014) reported that inquiry-based learning is very time-consuming both in the preparation and application/implementation and that any inquiry-based activity does not occur automatically, or without much trial and error. Gutierrez (2014) supports the difficulty and time- consuming nature of inquiry approaches as an important challenge in implementing inquiry-based teaching. Mike (2017) had also indicated that it takes time and preparation to develop a full inquiry-based class. Dell'Olio and Donk (2007) added that it takes a lot more effort for a teacher to scaffold a lesson than to simply give students the required information. Nevertheless, the authors pointed out that by scaffolding a lesson and then allowing student inquiry to guide it, teachers are offering students a way of thinking that will last a lifetime, and this is through using the inquiry-based approach in the classroom. The authors also highlighted the need for teachers to be well-versed in inquiry and inquiry-based methods to use inquiry thoughtfully and appropriately in their classrooms.

CONCLUSIONS

It can be concluded that there is a relationship between the teacher's mental construct of IBA and practice. How the teachers formed their mental constructs relied on how they discussed the topics. Based on the results, the teachers' mental construct involved useful and positive views and perceptions on the use and implementation of IBA. The teachers' positive perceptions include that inquiry approach is a paradigm shift, student-centered, motivational, and promotes higher order thinking skills. On the other hand, the teachers also viewed the approach as having some negative implications or limitations. The limitations of IBA include that it is resource- and time- consuming and requires good prior knowledge and skills of students. The identification of the teachers' mental construct is very useful for guiding school administrators on how the curriculum should be implemented based on IBA. The teachers' perceptions on IBA as resource-and time-consuming imply the need for trainings and seminars focusing on designing activities and creating instructional materials that can be used easily and conveniently in the classroom setting. It is also suggested that the findings be used to design assessment instruments geared on measuring teachers' inquiry-based science teaching competencies that will set-up professional development inquiry-based science teaching programs for teachers. Recommendation on trainings about approaches to activate students' prior knowledge and skills be conducted.

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