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## **Lesson Study: Approach in the Development of Lesson Exemplar in Biology for Senior High School**

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### ABSTRACT

This research incorporated the principles of lesson study in the development of lesson exemplars in general biology 1 for senior high school. Teachers' need assessment was administered to determine the biology teachers' level of awareness on lesson study and learning gaps identified through the administration of a validated and reliability tested 30-item needs assessment survey questionnaire for lesson study group teachers and 60-item multiple choice - Test Questionnaire on Students Learning Gaps in Biology (TQSLG), respectively. Results showed that teachers' overall needs in the lesson study was described as "aware" additionally, one of the three dimensions on the teachers' role in lesson study was described as "partly aware" indicating that there are ambiguity in the understanding of teachers in the lesson study. Consequently, Grade 12 Senior High School learners exhibit "beginning" level of knowledge on topics of Cell structure and Function, Cell Types and Cell transport which in general was considered as learning gaps. The gaps identified directed the training of biology teachers on the lesson study and its execution to the development of biology lesson exemplars. The participants of the lesson study implementation include the following: six biology teachers and 88 Grade 12 STEM learners of a public high school in the province of Iloilo. Six lesson exemplars collaboratively developed by the lesson study group teachers which addressed the identified learning gaps was implemented using Lesson study. This includes Count me in! Cell parts and Function, Plant and Animal Cells: Side by Side, Tracing the phases of Mitosis, A walk along Meiosis alley, Free FLOW: Passive Transport, and No Energy, No Entry!. Moreover, teachers' reflection showed that lesson study are interesting, beneficial and student centered however the process was considered to be tedious and time consuming. Lesson study was found out to be beneficial both for the learners and the teachers. Collaboration, revision and re-teaching are important parts of the lesson study. Moreover, members of the lesson study must have a common schedule, a Learning resource center, support from administration and mandate to incorporate Lesson study in the curriculum are essential in order to facilitate the implementation of the Lesson Study.

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Keywords: Learning gaps, lesson study, lesson exemplars

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### **I. Introduction**

Advances in technology, science and learning science have reshaped science education which creates challenges in different countries around the globe. Science teaching had been singled out as a weak link in the Philippine educational system because of its low performance in Trends in the International Mathematics and Science Study (TIMSS). Certain factors was identified to be the cause of this low performance such as insufficient classroom, less support from local government for their instructional materials, training of teachers, nutrition, and living condition affect academic performance of learners' (Alcuizar, 2016).

Another factor which is being looked into is the learning gaps, which continue to rise not only in rural areas but in urban scenario as well, and when left untreated could lead to a tremendous effect. In line with this, the Department of Education was tasked to be the front liner in enhancing the level of education, stipulated in Republic Act 10533 or the Enhanced Basic Education Curriculum which promulgates to improve the quality of education and prepares high school learners' to be ready for higher education, work or employment, middle skill development, entrepreneurship and make them globally competitive ( Republic Act No 10533, s2013 ).

Teachers who are considered as key factors in learning is faced with a great challenge in achieving the vision of the K-2 education program (K-12 Toolkit Reference Guide for Teacher Educators, School Administrators and Teacher 2012). However, teachers in the field are faced with different obstacles which

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must be addressed in order that they could be effective in their line of duty. They may lack support from administration, learners, parents and colleagues. Moreover, a lot of work was entrusted on them, leaving them accountable for more than they should, not to mention the excessive paper works they have to comply, leaving them meager time to plan as well as no time in dealing with their personal needs. It was noted that teachers play an important role not only in the education system but also on the country's economic status. In this regard, teachers were sent to different seminars, symposiums, trainings and scholarships were granted especially in the field of Science, Technology and Mathematics in order to equip them.

In the same manner, a variety of teaching strategies is explored in order to ensure learners' learning; however it is difficult to tell which teaching strategy would fit to a particular class. Often times teachers would explore on the different teaching strategies that would fit to a particular group of learners, and the topic as well. Strategies like cooperative learning, inquiry based instruction, differentiated instruction, graphic organizer, introduction of ICT, are often utilized in classroom settings. This is to ensure that no child will be left behind in terms of teaching and learning.

One of the strategies being introduced in the field of education is lesson study. During lesson study, a group of teachers researches and writes a lesson plan on a particular topic. The teachers also write expectations for the lesson, how learners' will respond to it, whether it will help them understand a certain concept better, and how it will teach them to grasp that concept. Once the lesson is completed, one teacher from the group volunteers to teach it to his or her class, and the other teachers are given release time to observe the implementation of the lesson, and note if and how it met expectations. After that, teachers meet again, review notes, and decide what revisions are needed (Education World, 2008). The development of enhanced lesson exemplar, which is a detailed lesson plan equipped with a variety of activities that would cater to the diversity of learners' could really help teachers in the field especially those non biology or non-science majors, yet were tasked to teach General Biology for STEM learners'.

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## METHODS

This study aimed to develop lesson exemplars using lesson study approach. It employed mixed method, where a quantitative – qualitative is used in order to gain a more complete understanding of the research questions. Data will be taken from Test questionnaire, interview, transcript from planning and reflection, field notes/ observation notes, lesson plans/ teachers log, learners works, video analysis, teachers reflection form and interview with the respondents will be examined both quantitatively and qualitatively to determine the learners' learning gaps, common categories, themes and connection to each research question Creswell, J. W.(2013).

The participants in this study were the six science teachers major in Biology who are teaching Biology for Junior and Senior High School in one of the public schools in the province of Iloilo were purposively chosen to be participants for this study. These science teachers are teaching Biology in different school programs of one of the public school in the province of Iloilo such as the Senior High School ( SHS), Special Science Class (SSC) School of the Future ( SOF) School of the Performing Arts (SA) Evening Opportunity Class (EOC) School for Sports and the Regular Class which formed the lesson study group. Eighty STEM grade 12 Senior High School learners for pilot testing, results were utilized for reliability of the instrument. Sixty two STEM grade 12 Senior High School learners were utilized for diagnostic test. Eighty eight grade 12 learners were asked to be the participants during the conduct of the lesson study. Results were used to determine learning gaps and eighty eight STEM grade 12 Senior High School learners served as lesson study proper participants.

Two researcher made questionnaire were used in this study : the Test Questionnaire on Students' Learning Gaps in Biology (TQSLG)– this was used to gather quantitative data needed to determine learning gaps in General Biology 1. It is made up of 60 multiple choice test items based on the K-12 Curriculum guide of the Department of Education. It is classified under the three learning content which includes the Cell, Biological Molecule and Energy Transformation. The said instrument was validated by 5 experts in their chosen field; 2 science teachers ,a research teacher, a math teacher and a grammarian served as validators, this then was pilot tested to 80 grade 12 STEM learners of the selected school. Diagnostic was given to 62 grade 12 STEM learners of the said school. Results were subjected to Statistical Package for Social Science (SPSS) using mean and standard deviation. The instrument has a reliability coefficient of 0.800 and it was used to gather data on the learners' learning gaps. On the other hand a Survey Questionnaire on Lesson Study Group Teachers level of awareness on lesson study was implemented to Biology teachers who are part of the lesson study group. Lesson study instructional effectiveness survey, field notes and video analysis, teachers' weekly reflections, and semi structured interviews were utilized to gather qualitative data.

Prior to data collection, permission to gather data from teachers and learners during the 1st grading period were secured from the Science Supervisor of the Division of Iloilo. After permission was granted, pilot testing and data gathering were conducted on randomly selected learners of the selected public school. Respondents were given ample time (30 minutes to an hour) to fully accomplish the test questionnaires. Thereafter, the questionnaires were retrieved and responses were encoded. Care was taken so as not to include learners who were part of the pilot test among the respondents. Result of TQSLG was used as bench mark for developing lesson exemplar which was implemented during the lesson study.

The interconnection among input, throughput and output are shown in figure 1, which defines the direction and methods used in the study.

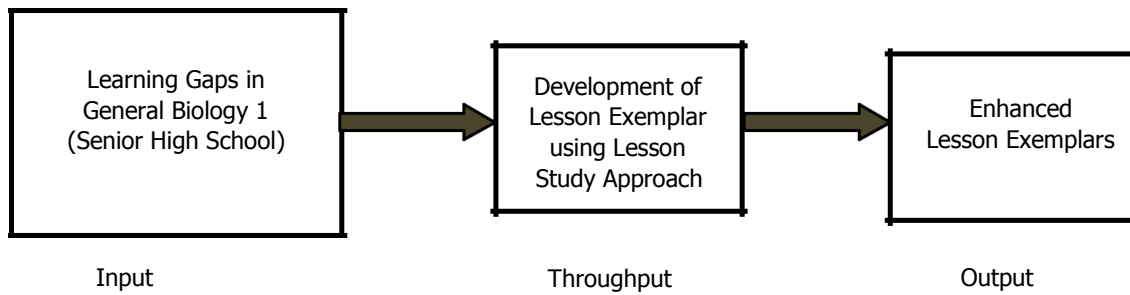


Figure 1. The research paradigm

Figure 2 shows the procedural flow of the conduct of the study

Figure 2 . Flow chart

### Flow Chart of Data Gathering Procedure

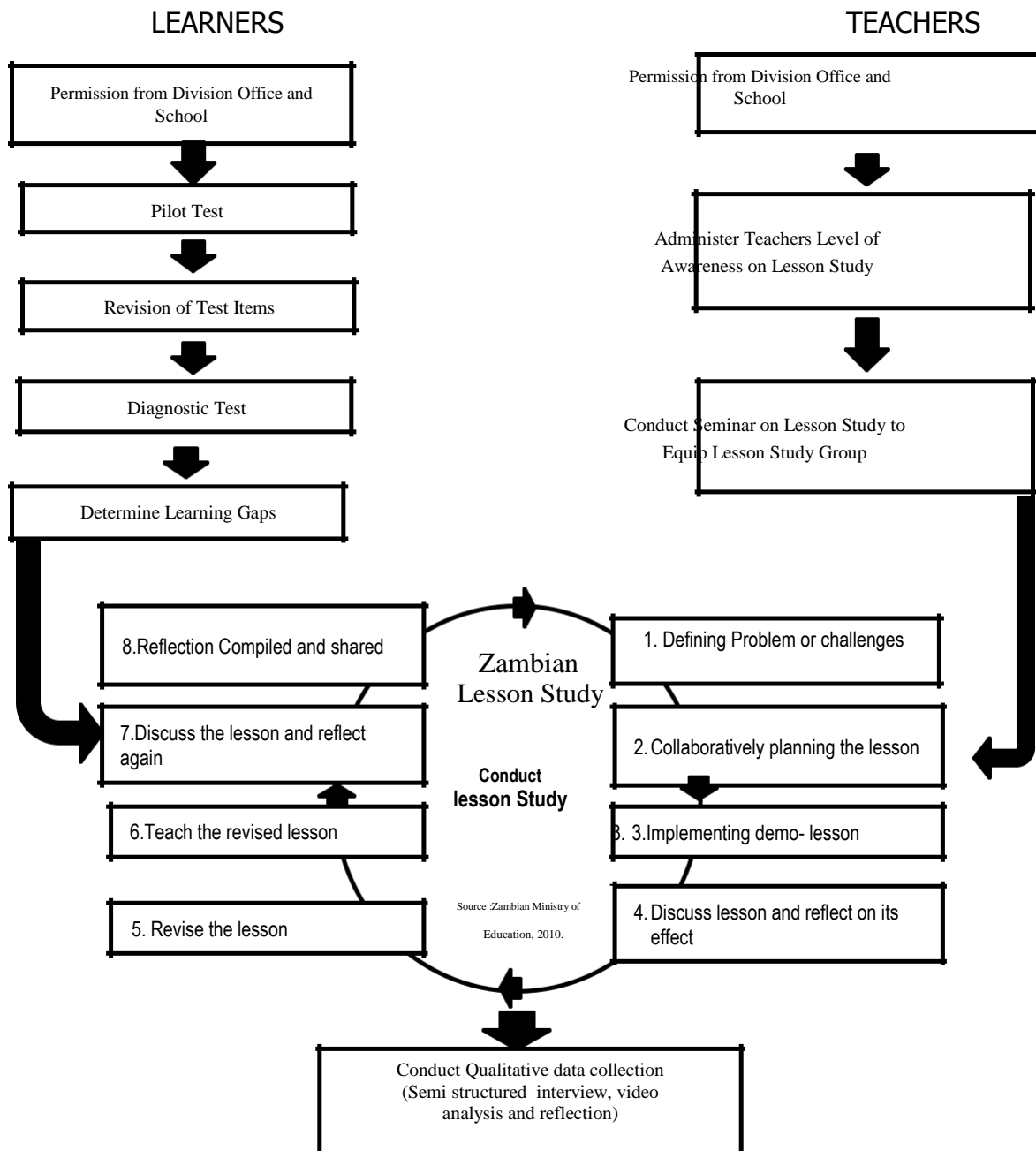


Table 1 shows the level of performance and the corresponding number of hours needed for remediation.

**Table 1- Level of Performance**

Level of performance	Number of hours for Remediation
<b>Advanced ( 90% and above )</b>	
<b>Proficient ( 85-89%)</b>	
<b>Approaching Proficiency ( 80-84%)</b>	20-30 mins of in school remediation every other day
<b>Developing ( 75-79)</b>	30- 45 mins of in school remediation
<b>Beginning ( 74% and below )</b>	1 hr of in school remediation daily+ extra time for off school practice

## RESULTS

Reflected on table 2 is the learners' level of knowledge towards cell. Data revealed that Senior High School Learners have "Beginning" knowledge in terms of Cells content. Students level of knowledge on Cell content shows that learners scored "beginning" in cell theory ( = 2.68, *SD* .672 ), cell structure and function ( = 1.94, *SD* .765), Prokaryotic and Eukaryotic cells ( = 1.94, *SD* =.823 ), cell types ( = 1.90, *SD* .762) and cell modification ( = 2.47, *SD* = .695) . A mean score of 2.68, 1.94, 1.90 and 2.47 when computed would have a numerical value of 74% and below and a description which is "beginning". According to Dep Ed Order 73 s 2012 students at this level struggles with their understanding prerequisite and fundamental knowledge or skills have not been acquired or developed adequately to aid understanding. In this regard, topics on cells were considered to be learning gaps which require remediation in order to mitigate the said learning gaps.

**Table 2- Level of Learners knowledge on cells**

Content Standard	<i>n</i>	<i>SD</i>		Description
<b>Cell Theory</b>	62	.67	2.68	Beginning
<b>Cell Structure and Function</b>	62	.77	1.94	Beginning
<b>Prokaryotic and Eukaryotic Cells</b>	62	.82	2.55	Beginning
<b>Cell Types</b>	62	.76	1.90	Beginning
<b>Cell Modification</b>	62	.70	2.47	Beginning

Note :  $\bar{x}$  – Mean; *SD*- Standard Deviation; D – Description; 3.60– 4.0 Advanced (A); 3.40 – 3.59 Proficient ( P); 3.20 – 3.39 Approaching Proficiency (AP); 3.00- 3.19 Developing (D); 0.00 -2.99 Beginning

Table 3 shows the level of learners' knowledge on cell cycle. The computed data reveal that senior high schools learners of one of the public schools in the province of Iloilo have " beginning" level of knowledge cell cycle ( = 2.26, *SD*= .745), Mitosis ( = 2.19, *SD*= .865) Meiosis ( = 1.98, *SD*= .820) and Diseases ( = 2.52, *SD*= .987). Data revealed that learners at this level struggle with his /her understanding on the mentioned concepts; furthermore, prerequisite and fundamental knowledge and or skills have not been acquired or developed adequately by the learners in order to aid understanding. Mean score on this concepts was computed and revealed that its numerical value falls on 74% and below signifying that it was considered as learning gaps. This also shows that concepts on these areas most undergo remediation to further enhance learning.

**Table 3 Level of Learners knowledge on cell cycle**

Content Standard	<i>n</i>	<i>SD</i>		Description
<b>Cell cycle</b>	62	.75	2.26	Beginning
<b>Mitosis</b>	62	.87	2.19	Beginning
<b>Meiosis</b>	62	.82	1.98	Beginning
<b>Diseases</b>	62	.99	2.52	Beginning

Note :  $\bar{x}$  – Mean; *SD*- Standard Deviation; D – Description; 3.60– 4.0 Advanced (A); 3.40 – 3.59 Proficient ( P); 3.20 – 3.39 Approaching Proficiency (AP); 3.00- 3.19 Developing (D); 0.00 -2.99 Beginning (B)

Table 4 contains the results of the level of learners' knowledge on transport mechanism. Results show that learners exhibit "beginning" level of knowledge on areas such as Transport mechanism as evident in ( = 1.98, *SD*= .967), Facilitated Diffusion ( = 1.95, *SD*= .847) Active Transport ( = 1.95, *SD* = .876) and Bulk/ Vesicular Transport ( = 1.92, *SD*= .775)

**Table 4 - Level of learners knowledge on transport mechanism**

Content Standard	n	SD		Description
<b>Transport Mechanism</b>	62	.97	1.98	Beginning
<b>Simple Diffusion</b>	62	.85	2.94	Beginning
<b>Facilitated Diffusion</b>	62	.91	1.95	Beginning
<b>Active Transport</b>	62	.88	1.95	Beginning
<b>Bulk/ Vesicular Transport</b>	62	.78	1.92	Beginning

Note : – Mean; SD- Standard Deviation; D – Description; 3.60– 4.0 Advanced (A); 3.40 – 3.59 Proficient ( P)  
3.20 – 3.39 Approaching Proficiency (AP);3.00- 3.19 Developing (D); 0.00 -2.99 Beginning

Results show that learners have beginning level of knowledge in cells, cell cycle and transport mechanisms. Topics whose description fall under beginning to approaching proficiency were considered to be learning gaps, which becomes the starting point of the lesson study. However the lesson study group decided to come up with six topics to implement, these topics were considered to be least mastered or those scores which are considered to be the lowest among the listed learning gaps, these include cell structure and function, cell types, cell cycle, mitosis, meiosis, transport mechanisms, facilitated diffusion, active transport and Bulk / Vesicular transport.

A thorough study of the result shows that there is a diversity of learners. This is because some students learn through hearing and appreciate lecture method while others can grasp ideas by looking through pictures, charts and graph, others appreciate hands on activities and learn through manipulation while others enjoy bodily movement as it is being incorporated in classroom activities. Figure 5 to 7 show the diversity of students in topics cell structure and function, cell cycle and cell transport.

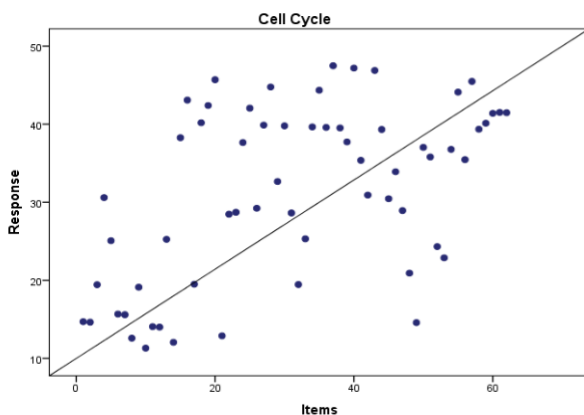


Figure 5 Diversity of learners' response on cell structure and function

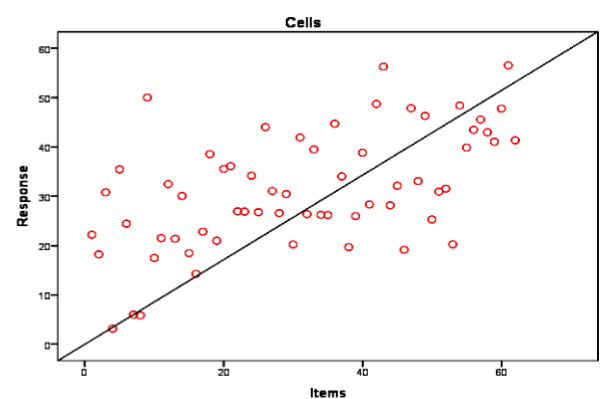


Figure 6 Diversity of learners' responses on cell cycle

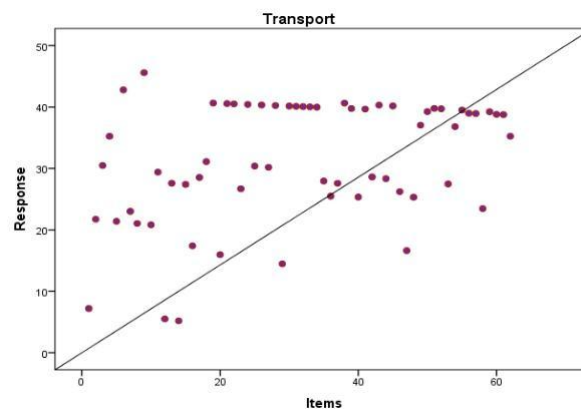


Figure 7 Diversity of learners' response on Cell Transport

Figure 5 to 7 show the distribution of students' responses in three main topics as being depicted on the scatter plot. These show that students are diverse for there is a wide range of learning diversity in schools. Diversity in education is evident in a number of student characteristics, including gender, race/ethnicity, socio economic status, learning ability, and language proficiency as stated by Ruggs, Enrica & Hebl, Michelle (2012). In every classroom, it commonly occurs that students' learning progress is never at the same rate because each student has his or her own learning style. This is due to learners' multiple intelligences.

In this regard the lesson study group designed a variety of learning activities which were incorporated in the lesson in order to cater to the diversity of learners.

### Lesson exemplars developed to address the learning gaps

Learning gaps when identified at the earliest can be reparable in nature. However if it left unattended at an early stage, over time they bloom into such intensity ( Words worth , 2013). This can increase the chances that a student will struggle academically and socially or drop out of school ( The Glosary of Educational reform 2014). These gaps may be repaired only after intense remedial intervention which must be done right away. The identified learning gaps is considered to be basic concepts in Biology which are also included in the Junior High School curriculum. However results shows that learners were not able to have a concrete knowledge of the mentioned topics. It is the objective of the lesson study group to develop a lesson exemplar that would address the gap and at the same time would cater to the needs of the diverse students. The exemplar covers topics for the 1<sup>st</sup> grading period with the main focus on cells. Table 7 shows the list of the developed lesson exemplar, learning content, list of activities, assessment and the learning competencies codes.

Reflected on table 7 are the different lesson exemplars that were developed by the lesson study group. These exemplars were designed to help teachers deliver a quality classroom discussion on the above mentioned least mastered skills.

This exemplar presents a detailed lesson plan, complete set of materials, video clips and a power point presentation, this then will greatly help the teacher to carry out the lesson with ease and confidence.

**Table 7a Collaboratively developed lesson exemplar**

Learning gaps	Lesson exemplar developed	List of activities	Assessment	Competencies Code
<b>Cell Parts and Functions</b>	<i>Count me in !</i> Cell parts and Function	Elicit - Picture Analysis of Living Things Engage - Word Mining Who am I? Explore - Yummy Cells Explain – Paired discussion Extend - Cell Rap Elaborate- Class discussion Evaluate- Paper and Pencil Test	Students correct responses on paper and pencil test  Evaluation using rubrics provided 1. 2. Correct responses on different activities presented	STEM- BIO11/12-Ia- c-3
<b>Cell Types</b>	<i>Plant and Animal Cells: Side by Side</i>	Elicit – Cell Bowl Engage – 4 pics 1 Word Name Game Explore – Plant and Animal Cell ( Microscopy) Explain –Post Activity Discussion Elaborate-comparing plant and animal cell Extend- Paired Discussion using screen mirroring Evaluation – students' correct responses towards cell types	Students correct responses on paper and pencil test	STEM- BIO11/12-Ia- c-4
<b>Mitosis</b>	<i>Tracing the phases of Mitosis</i>	Elicit – comparing plant & animal cell - Animal Kingdom Engage - Agent Mitosis Explore- A peep through Mitosis Explain – class discussion using students answers in their lab activity. Elaborate- class discussion, Extend- Video viewing Evaluation- Model making	Students' correct responses on paper and pencil test  Evaluation using rubrics provided  Accomplished Laboratory activities  Correct responses on different activities presented	STEM- BIO11/12-Id- f-7

Table 7b Collaboratively developed lesson exemplar

Learning Content with Identified Learning gaps	Lesson exemplar developed	List of activities	Assessment	Learning Competencies Code
Meiosis	<i>A walk along Meiosis alley</i>	Elicit – Peel a cabbage Puzzle Engage – Guess and tell Explore – A walk through Meiosis Explain – Class discussion using students responses on gallery walk. Elaborate – class discussion Extend- Class room discussion Evaluation- Paper and Pencil test	Students' correct responses on paper and pencil test  Accomplished Laboratory activities  Correct responses on different activities presented	STEM- BIO11/12-Id-f-8
Passive Transport	<i>Free FLOW: Passive Transport</i>	Elicit – Shoot that membrane ball Labelling of cell membrane Taste test challenge Engage – Guess What Explore - Hit that target Explain - Classroom discussion Elaborate- Focus group discussion Extend - KMJS viewing Evaluation- Paper and Pencil test	Students' correct responses on guess what Accomplished  Laboratory activities Correct responses on different activities presented  Correct responses on paper and pencil test	STEM- BIO11/12-Id-f-8
Active Transport	<i>No Energy, No Entry !</i>	Elicit - Peel that banana Picture analysis Engage – “hangman” Concept Mapping Explore- Video Analysis Explain – Class discussion/ post activity discussion Elaborate - Class discussion Extend - Strengthen thy concept Evaluation- Haiku writing	Correct answers on review   Evaluation using rubrics provided	STEM- BIO11/12-Id-f-8

### Evolution of Lesson Exemplar (1<sup>st</sup> implementation)

In order to ensure a quality lesson exemplar several steps were undertaken and several revisions were conducted as it passed through the hands of the lesson study group teachers. The lesson exemplar went through two major revisions and two implementations before it was declared ready to be shared with other biology teachers in the field. Lesson study 1<sup>st</sup> implementation was conducted in one of the public schools in the city of Iloilo. Cell Structure and Function was the 1<sup>st</sup> topic that was implemented with one biology teacher who implemented the lesson to 44 students of section B of the said school. During the conduct of the study 3 teachers served as teacher observers at the same time 4 members of the panel were there to observe the 1<sup>st</sup> implementation.

The 8 exhibits the different comments and suggestions of the members of the panel and the lesson study group, as well as, the action taken in order to ensure an enhanced lesson exemplar that would mitigate learning gaps.

**Table 8 Evolution of Count Me In! Cell Parts and Function (1<sup>st</sup> Implementation)**

	<b>Suggestion</b>	<b>Action Taken</b>
1	Biology Laboratory is too crowded for the students, students and teacher observers could not move due to limited space	2 <sup>nd</sup> implementation was conducted at Pagcor 201, the learners' advisory classroom where students and teachers observers were provided with enough space for the learners to collaborate with their classmates.
3. 2	4. Omit beautifying a circle as a motivation it is time consuming.	Beautifying a circle as motivation was omitted. Review and Motivation was fused as one.
3.	Add connectors from one part of the lesson to another part.	Connectors were added on the exemplars
4.	Process questions where vague.	Process was simplified
5.	Add a taste of inquiry on the lesson presented	Guide questions were revised where higher order thinking skills were incorporated.
6.	Teachers should have an input before proceeding to the next part of the lesson	Additional information was given before proceeding to the next part of the lesson
7.	Search for a term that could be used as an alternative for unlocking of difficulties. Do not include meaning or functions of words on the unlocking of difficulties.	The term unlocking of difficulties was changed to Vocabulary building. Words in the unlocking of difficulties was only unlocked but not defined.
8.	There should only be one worksheet per group to allow the members to give particular attention to group discussion.	One activity sheet was given per group, secretary of the group noted down was taking place during the group activity.
9.	Use screen mirroring in presenting group output group sharing should be non-repetitive where in concepts mentioned by one group should not be repeated by another group.	Screen mirroring was utilized to showcase group output. Class sharing was not repetitive for groups were assigned to discuss certain parts.
10.	Construct evaluation that would encourage higher order thinking skills.	Evaluation was revised where higher order thinking skill questions were incorporated

**Evolution of lesson exemplar (2<sup>nd</sup> Implementation)**

The lesson exemplar was revised and implemented twice. Comments and suggestions from the 1<sup>st</sup> implementation was incorporated on the 2<sup>nd</sup> lesson exemplar. This exemplar was implemented by another Biology teacher from the selected public school where 3 members of the lesson study group served as teacher observers. This time implementation took with section A as student participants of the lesson study and as suggested by the lesson study group members giving the learners a wider space to conduct classroom activities. Screen mirroring was used during class discussion, as well as, class presentation of the students' output. The researcher saw to it that all revisions noted on the 1<sup>st</sup> implementations were carried out during the conduct of the 2<sup>nd</sup> implementation. However, it was noted that there was lesser correction during this stage than that of the 1<sup>st</sup> implementation. Table 9 shows the recommendations and suggestions of the lesson study group members.

**Table 9 Evolution of Count Me In! Cell Parts and Function (2nd Implementation)**

	<b>Comments</b>	<b>Action Taken</b>
1.	Add connectors in the engage part, which is prior to the of the lesson discussion	Connectors were added to ensure further understanding of the study
2.	Give a detailed instructions on how sharing should be done	A detailed instructions to the learners were given.
3.	Set the volume of the video presentation to ensure that even the last person at the back portion of the room could hear the presentation.	Volume was check to ensure students participation and group activities went on according to what was planned.
4.	The flow of the lesson is systematic, organized and learners are engaged.	
5.	Good Job Congratulations!	



## Findings

The findings of the study were as follows

1. The learning gaps in General Biology among Grade 12 Senior High School learners described as “beginning” are the following: Cell structure and function, cell types, cell cycle, mitosis, meiosis, transport mechanisms, facilitated diffusion, active transport and Bulk / Vesicular transport.
2. Six lesson exemplars were collaboratively developed by the lesson study group teachers which addressed the identified learning gaps. The following are the lesson exemplars’ developed: *Count me in!* Cell parts and Function, *Plant and Animal Cells: Side by Side*, *Tracing the phases of Mitosis*, *A walk along Meiosis alley*, *Free FLOW: Passive Transport*, and *No Energy, No Entry!*
3. The Biology teachers that comprised the lesson study group found lesson study to be interesting and beneficial to them because it improves their professional and personal skills. Since it is student-centered it also motivates the students to be participative in class activities. The Lesson study group also found collaboration, revision and re-teaching as important parts of the lesson study. However, they consider the process to be tedious and time consuming. In order to facilitate the implementation of the Lesson Study the group suggested that members of the lesson study must have a common schedule, a Learning resource center, support from administration and mandate to incorporate Lesson study in the curriculum.

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## Conclusions

Based on the findings of the study, the following conclusions were arrived at:

Basic concepts such as cell structure and function, cell types, cell cycle, mitosis, meiosis, transport mechanisms, facilitated diffusion, active transport and Bulk / Vesicular transport which was introduced in Junior High School were not mastered by the learners, time constrain, curricular expectations, lack of motivation, individual differences or because of the complexity of concepts which is beyond the grasp of a Junior High School learners. These learning gaps can be addressed by incorporating lesson study in preparing the lesson exemplars that can be used to teach them in order to prepare the learners for much higher and complex concepts and to prevent wider learning gaps in the future.

Lesson exemplars equipped with a variety of activities that illicit a participative environment which challenged multiple understanding and connected to practical phenomena for diverse group of learners that can best address the learning gaps in Biology. The lesson study provides an interesting and beneficial experience of Biology teachers as members of the lesson study group in terms of the following: 1) it enhance their pedagogical skills and 2), it allows collaboration among biology teachers as venue for revision and re-teaching which developed their interpersonal skills, and lastly 3) improves their conceptual understanding of the biology lessons. However, they have considered the process of the lesson study to be tedious and time consuming. In order to facilitate the implementation of the Lesson Study the group suggested that members of the lesson study must have a common schedule, a Learning resource center, support from administration and mandate to incorporate Lesson study in the curriculum. Moreover, the biology exemplars as product of the lesson study provide the following advantages to the learners: 1) it is student-centered, 2) it motivates the students, 3) it encourages active and collaborative participation in class activities, and 4) it gives various learning opportunities for the learners’ with diverse learning styles.

## Implications

The findings of the present investigation have led to certain implications for theory and practices in relation to the lesson study as an approach in the development of lesson exemplar for Senior High School

## For Theory.

The Junior High School lays the foundation for students success in the senior high school, however many learners leave junior high school unprepared for the daunting task of senior high school. Learners were not able to master prerequisites concepts due to time constraints, curricular expectations or concepts which are beyond the students grasp could eventually lead to learning gaps which must be filled. It is in this context that Variation theory of learning by Ference Marton comes in, this theory provides a rather unique perspective on learning and teaching relationship between what has taken place in the classroom and what the learners learn and identify ways to improve students learning through promoting teacher professional learning in a learning study setting. Furthermore the critical aspect in the lesson content and establishing a pattern of variation should be the starting point for planning, rather than teaching strategies or methods. In this regard learning gaps must be identified in order to be address preventing future decline in learners social and academic performance.

In relation to the theory of Multiple Intelligences, Howard Gardner suggested that all people have different kinds of "intelligences.". People do not have just an intellectual capacity, but have many kinds of intelligence, including musical, interpersonal, intrapersonal, spatial-visual, logical- mathematical, bodily kinaesthetic, naturalistic and linguistic intelligences. This then suggest that a person might be particularly strong in a specific area, such as musical intelligence, he or she most likely possesses a range of abilities such as verbal, musical, and naturalistic intelligence. In this regard diversity of learners would be catered by exposing the learners in diverse activities that could address individual differences.

In addition, Social Constructivism – Collaborative learning theory by Vygotsky points out that development and learning are not the same but are considered to be a dynamic process that results in gaps of development level that must be addressed through social cooperation and interaction with more capable person. The theory further points out that learning is promoted through collaboration among students, between students and teachers as well as between teachers and teachers. It was noted Lesson study improves teacher professional and personal skills through collaboration for it allow teachers to share and exchange fresh, new and brilliant ideas, explore new teaching style and unlock misconceptions in order to improve lesson that would suit to the students' needs allowing the students to explore, and engage in hands on activities for a much concrete learning concepts.

### For Practice.

Topics in Biology are taught in proper sequence as it appears in the course outline provided by the Department of Education. It was expected that learners had mastered the basic concepts before proceeding to next level, however findings of this study provides insights that learning gaps do exist which may be brought about by time constrain, curricular expectations, lack of motivation, individual differences or concepts which are beyond the learners grasps. Thus it is necessary to identify these learning gaps in order to be able to address them.

Usually, Biology teachers are limited to the use of the DepEd prescribed learning module and have not ventured into a collaborative approach of designing a lesson however, teachers can deviate, localize and collaborate to form a lesson study group to develop lesson exemplars that suit their learners interest , cognitive skills and learning environment.

In forming the Lesson Study group factors like common time of each teachers, availability of resources and facilities and commitment of each member among others shall be considered for the success of the lesson study.

### Recommendations

Based on the aforementioned findings, the following recommendations are advanced:

1. The Department of Education may promote the integration of Lesson study in science subjects to encourage collaboration among teachers
2. Science Curriculum Planners may look into the content of the curriculum guide in order to prevent overlapping of topics, and at the same time decongest/ trim down the number of competencies that must be discussed for each grading period. They may assign a day with a double period time schedule to allow implementation of lesson study.
3. Policy Makers may institute in their memoranda the implementation of lesson study by incorporating it into the School-Based Learning Action Cell (SLAC) and for specific specialization to have Learning Action Cell (LAC).
4. Professional Organization may organize activities/ seminars that will deal with learning gaps, as well as introduction of lesson study as a way to approach subjects and topics that are found to be least mastered by the learners.
5. School Administration may continue to give support to the implementation of lesson study by: (a) arranging schedule of teachers to have a common time in each subject to encourage collaboration, and (b) provide a learning resource center for output of the lesson study making it available for everybody
6. Science Teachers are encouraged to join / form lesson study group in order to collaborate, create and use a student-centered lesson exemplar.
7. Students may give feedback about the lesson study which will become the basis for further improvement and monitoring of teaching and learning experiences, and impact of the lesson study to the performance of teachers and learners.
8. Future Researchers may conduct parallel study to the Junior High School since it is limited only to Senior High School.

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