Field-Based Laboratory Instruction in Teaching Forces, Motion, and Energy

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Abstract: Although the integration of field-based instruction was a successful teaching method for increasing students' knowledge of the subject, few practitioners use it as a method for the science teaching and learning process due to the dearth of studies demonstrating its efficacy. With this, the study aimed to utilize field-based laboratory instruction (FBLI) to increase the students' performance in science, especially in force, motion, and energy. The study used a descriptive, quasi-experimental research design supported by a phenomenological and narrative research method to enable the description of the performances of the student-respondents before and after exposure to Field-Based Laboratory Instruction (FBLI) in teaching physics concepts. Before being exposed to the FBLI, the mean percentages of students were 69.30; SD = 2.24, indicating that they did not meet expectations in the areas of force, motion, and energy. However, upon utilizing FBLI, there is an increase in the mean performance of students that is fairly satisfactory. Results implied that there was a shift in performance with the use of FBLI. The FBLI is a useful tool to help improve the performance of students and provides learning through conducting actual or concrete activities. It is suited to junior high school learners because it was good and enjoyable. Further, getting involved in the activities aligned with FBLI makes students excited to learn new things in a unique way. A well-planned lesson is necessary to deliver meaningful experiences using FBLI, from the preparation of instructional materials and classroom management up to the precautionary measures to be considered in conducting field instruction.

1. Introduction

When compared to English and mathematics, science is one of the secondary school core subjects with the highest units in the grade system. Both successful and unsuccessful students find learning science to be challenging due to subject's dogmatism and abstract in nature (Mustacisa, 2016). In terms of instruction, it is handled and managed differently from other disciplines (Darling-Hammond et al., 2019). Science in the new K to 12 curricular programs is a progression in content that topics are continuous from grades 1 to 12. The new system requires students from grades 1 to 12 to have in-depth retention in terms of content and analytical skills.

Science teaching in K-12 curriculum is an integration of various Science disciplines such as Biology, Chemistry, and Physics) and spiral in the content taught in Junior High School (De Ramos-Samala, 2018), which will build the student's ability to think critically, analytically, and holistically. The teaching and learning process in Science must be contextualized and based on the experience of the students. Thus, bringing students closer to the environment plays an essential role in science education (Mcdaniel, 2020).

Science teaching in most schools today is a teacher-centered and confine inside the classroom; teacher dominates class discussion by giving information to students through the conventional method of talk and chalk (Shah, 2019 & Lamesa, 2017). It contributed to students' poor performance in sciences, as observed by many scholars (Kola et al., 2013). Based on the results of the Program for International Student Assessment (PISA) last December 2018, Philippines obtained an average score of 357 points for scientific literacy which is significantly lower than the average Organization for Economic Co-operation and Development (OECD) points of 489 among ranked countries. The mean scientific literacy score is within Proficiency Level 1 (DepEd, 2015).

On the other hand, the 2018 NAT results revealed for the last consecutive three years that is from 2015-2017, the national average Mean Percentage Score (MPS) in the Grade 6 NAT continued to decline at 37.44, which is the weakest performance in the history of the standardized examination of the Department of Education (DepEd). Meanwhile, the Grade 10 MPS of 44.59 improved by 0.51 over the score in 2017 of 44.08. The results obtained clearly defined that the Grade 6 takers in the 2018 NAT got less than four correct answers out of every ten items, while the Grade-10 takers averaged is four out of ten. Both scores, fall under the "low mastery" level in the (Dumo, 2019).

This is a similar scenario with DepEd Samar Division, although the division has no NAT results in the last three years their Mean Percentage Score although above passing percentage which of 75%, their MPS are relatively at low mastery level. It was 74.24 for the 2017–2018 academic year, 77.14 for the 2018–2019 academic year, and 79.11 for the 2019–2020 academic year (DepEd Samar, 2020).There is a need to make Science learning more engaging through student-centered instructions (Granger et al., 2012).

The study of Gomba (2010) on the field-based laboratory for teaching water resources engineering concluded that the post-test scores of the students were significantly higher than the pretest, which showed that the students gained more knowledge and skills from their assigned tasked. Sontay et al. (2018), also found out from their study the effect of the out-of-school science learning environment on understanding the nature of Science of the 7th-grade students in secondary school. The conclusion that the educational trip to the out-of-school learning environment positively influenced the 7th-grade secondary school students' understanding of Science.

The studies mentioned that, although the integration of field-based instruction was a successful teaching method for increasing students' knowledge of the subject, few practitioners use it as a method for the science teaching and learning process due to the dearth of studies demonstrating its efficacy (Han, 2020 & Kinskey, 2018).

Field-based education needs preparation, awareness, engagement, and meta-learning, build upon, illustrated, and asses, according to Queens University (Queen's University, 2019). Development of the said learning instruction is through the formulation of activity sheets and daily lesson plans made by the teacher. The distribution of these materials to the students is during the orientation, before the conduct of field-based instruction.

The field-based laboratory requires appropriate and contextualized instructional materials, which are very important in science teaching and learning in any teaching methodology used (Ingrid, 2020). The implementation of the K to 12 curriculum in the Philippines demands updated and contextualized instructional materials prepared explicitly for specific teaching methodology.

Proper planning prevents poor performance, which is the very reason why teachers need to prepare lesson plans to avoid inadequate classroom discussions. The teacher must be academically equipped and physically ready to handle field-based instruction. To do this innovation, proper planning with appropriate teaching-learning materials. Lesson planning for field-based teaching helps teachers conceptualize and design activities to teach to the students, and focus on the basic knowledge first then take students towards the higher concept (D'hondt, 2017).

The teacher must prepare a teaching guide to help students recall students' performance in schools through the use of activity sheets or written guides that they utilize in performing students' activities, and teachers make sure that the objectives of the events are understandable and measurable by the students. Teachers also prepare and use different methods for the students to understand the topic, and one of the methods includes giving or exposing students to real-life artifacts to assist better understanding and remembering the subject to be taught (Carnegie Mellon University, 2020).

This study is conceptualized and done to utilize field-based laboratory in teaching Physics in Grade-9. The inclusion focused on specific topics in Motion, Force, and Energy, these topics are appropriately used outside the classroom with a localized setting and contextualized contents. The researcher determined the most appropriate teaching-learning materials and its delivery related to the students. The study hoped to increase the performance of the students on the topics above as well as the experiences of the students and teachers using the field-based laboratory.

2. Objectives

This study evaluated students' performance before and after exposure to field-based laboratory instruction and their experiences as well as their teachers' experiences in using the said approach in teaching motion, force, and energy.

It specifically, this study sought to attain the following:

1. determine the performances of the students along with the following:
   1.1 pre-test, and
   1.2 post-test after exposure to field-based laboratory instruction

2. validate if field-based laboratory instruction is effective in teaching motion, force, and energy.

3. describe the students' and teachers' experiences in using field-based laboratory instruction.

3. Methodology

Research Design

The study used an embedded mixed method design, in which it uses one-group pretest-posttest quasi-experiment research designs and is supported by phenomenological and narrative research approaches. The descriptive with a quasi-design enables the researcher's description of the performances of the students-respondent before and after exposure to Field-Based Laboratory Instruction (FBLI) in teaching Physics Concepts using a questionnaire. The quasi-experiment was sought because it is challenging to conduct random assignment to the respondents to be involved in this study (Cowell 2012). The respondents took the pretest prior to exposure to FBLI and posttest was also conducted after exposure to FBLI to check if there is a significant increased on their performance.

The researcher also utilized a phenomenological research approach for the student-participants' experiences on the conducted activities on FBLI, and it is for the identification of themes that supports the advantages and disadvantages of the intervention. For the teacher who did the FBLI, the narrative research approach is utilized for the same purpose as the student-participants.

Instrumentation

For the pre and post-tests, the use of a researcher-made test that follows the competencies and standards set by the Department of Education was utilized for the FBLI. The Daily Lesson Log is also anchored to the standards set by the Department of Education, validated and checked by the educational experts.

The pre-and post-tests are of the same contents, with 52 items subdivided to competencies on topics Force, Energy, and Motions. There are 13 competencies, four questions for each skill, and tiered with definition, description, and two (2) different applications. The test is not yet standardized, but improvement could be carried out for future utilization of other researchers.

The interview guide for the students and teachers is solely designed to collect their experiences on the exposure to FBLI, it is constructed after quantitative analyses were performed.

Validation of Instrument

The researcher-made pretest and posttest followed the expert validation. The draft questionnaire was presented to three (3) experts in teaching Physics concepts for their inputs, suggestions, and recommendations. The revised test was dry-run in Casandig National High School, Paranas Samar, Philippines using the Grade 9 science classes. The self-made test was revised until the experts and the research adviser approves the said test for fielding.

Sampling Procedure

The study used complete enumeration wherein all students in Grade 9 Science class in Lawaan National High School, Paranas, Samar, Philippines considered as the study respondents. The research respondents have a total of 34 students. They are selected as study respondents because the competencies in the grade level are mostly applicable for outdoor activities such as Force, Motion and Energy, thus field-based laboratory instruction is possible.

The teacher who is handling the class is also considered as key informant to narrate his experiences in conducting and facilitating the Field-based Laboratory Instruction.

Data Gathering Procedure

The researcher sought permits from the school head and parents of the students to allow them to have a field-based class in Grade 9. The barangay officials were also informed about the said field-based activities.

The data gathering starts by giving a pre-test to students in Grade 9. The researcher oriented the students on the field-based laboratory strategy in teaching physics, wherein the students are provided with written guides or procedures on how to conduct various activities. The students are directed to the field within Barangay Lawaan, Paranas Samar, Philippines. The students conducted field activities in physics concepts such as force, motion, and energy with the supervision of the researcher. After the lessons and activities, the researcher conducted a post-test.

Following the analysis of the quantitative results, interviews were conducted with the participants; once the data was saturated, the researcher discontinued the interview. A narrative report was also required for the experiences of the teacher handling the subject and the one who conducted and facilitated the field-based laboratory instruction. a trained teacher from the locale of the study.

Statistical Treatment of Data/Data Analyses

The study employed descriptive statistics such as frequency counts, percentages, mean, weighted mean, and standard deviation as to the projection or presentation of results for the pretest and posttest results of the respondents.

A Shapiro Wilk Test was used for normality to assure the appropriateness of the inferential statistics. Since it conforms with the assumptions, paired t-test is then proceeded with p-value at five percent margin of error to decide whether hypothesis of the study be accepted or rejected.

For qualitative data on experiences, thematic analysis was applied to utterances of student-respondents. The process is based on the work of Creswell (2014), it starts with organizing the raw data into proper documents, reading through the complete documents, coding the data, making themes, interrelating themes and interpreting the meaning of themes. For narrative data analysis it is also anchored with the same author. It starts with constructing the narratives, defining significant experiences, exploring categories, themes and experiences, and restructuring the narratives aligned to themes and experiences.

Ethical Consideration

The researcher of this study ensures that the data collected were treated with utmost confidentiality and secure all approval of the involved authorities prior to the conduct of the study. After the data were tallied it was shredded and disposed properly. The researcher guaranteed that the methodology was subjected for ethical review, and revised accordingly in conformity to the issuance of ethical approval certificate.

4. Results and Discussion

4.1 Students' Performances Before and After Exposure to Field Based Laboratory Instruction

Table 1 provides data of the students' performance before and after exposure to Field Based Laboratory Instruction (FBLI).

From the table, the performance of students before exposure to FBLI has a mean equivalent performance of 69.30, an indication that they did not meet expectations as to topics force, motion, and energy. However, upon utilization of FBLI there is an increase in the mean performance of students, from not meeting expectations to fairly satisfactory. Results implied that there is a shift in the students' performance with the use of FBLI. A fairly satisfactory performance specifies that the students met the competencies as basis forgiving remarks as passed (DO 8, s. 2015). The intervention thru FBLI provides minimal improvement on students' performance thus it needs consistent utilization and evaluation.

Table 1. Students' Performances Before and After Exposure to Field Based Instruction

Equivalent Performance and Description	Pretest		Posttest	
	f	%	f	%
80-84 (Satisfactory)	-	-	1	2.94
75-79 (Fairly Satisfactory)	-	-	18	52.94
below 75 (Did Not Meet Expectations)	34	100	15	44.12
Mean Performances	69.30 (Did Not Meet Expectations)		75.02 (Fairly Satisfactory)	

**Equivalent Performance and Description is based on DepEd Order No. 8, s. 2015*

4.2 Effectiveness of Field-Based Laboratory Instruction

The test validation is undergone before proceeding to statistical treatment of data, Shapiro Wilk Test value resulted to 0.1974 with skewness of 0.2029 which is potentially symmetrical. The data showed no outliers and assumed that After Exposure Minus Before Exposure to FBLI is normally distributed or more accurately or cannot reject the normality assumption. With this, data can proceed to paired t-test calculation.

It can be gleaned in Table 2 the statistical results on the validation of the null hypothesis (Ho) there is no significant increase in the performance of students before and after exposure to FBLI.

From the table, since t-stat (9.78) is higher than the critical t-value (2.03), hypothesis is rejected. It is supported by the p-value (2.79 e^{-11}) which is much lower than the level of significance at 0.05 which reinforces claim that there is a significant increase in the performance after exposure to FBLI as reflected in their mean equivalent performances (from 69.30 to 75.02). The statistical results implied that the difference between the average equivalent performance after, minus before exposure to FBLI (5.73) is big enough to be statistically significant.

Thus, FBLI is an effective tool to help improve students' performance in Force, Motion, and Energy. It is supported by some of the published literature that FBLI is intriguing and influential because it helps learners understand concepts and connect with the instructional framework, and unique learning setting (Kinslow et al., 2018). FBLI also enhances learning activities accessibility and an avenue to produce more meaningful instructional workshops (Feig et al., 2019).

Table 2. Statistical Results on Validation of Hypothesis

Category	*Mean*	*SD*	*Absolute Mean Difference*	*t-critical*	*t-stat (p-value)*	*Decision*
Pretest	*69.30*	*2.24*	*5.72*	*2.03*	*9.78*	*Reject Ho/*
Posttest	*75.02*	*1.97*			*(2.79 e^{-11})*	*Significant*

It is a recommendation that science teachers need to utilize more often FBLI to support new learning experiences of students.

4.3 Students' Experiences in Using Field-Based Laboratory Instruction

There are three themes that emerged in the narratives of the student-participants with the use of Field-Based Laboratory Involvement (FBLI). These themes are presented below:

Theme 1: Learned from the conducted FBLI performances

One of their experiences using FBLI is they learned from the conducted performances, as presented in the following utterances of the participants.

> "*I've learned sir because during the discussion I volunteer to perform a hands-on example and I can able to answer the guide questions easily because I am involved in performing the activity too."* (Participant 1)

> "*I'm excited to listen to the discussion and I've learned a lot because my group mates show how to perform the activity."* (Participant 2)

> *"It's a new kind of teaching for me, it's fun and the environment is with us during the learnings of the topic and I was able to understand the topic easily because we are the one performing the activity, there is retention on the discussion."* (Participant 8)

> *"My classmates are encouraged to go to school because the teaching is fun an it's easy to learn because we are the one performing the activity."* (Participant 10)

> *"I really enjoyed the Field base laboratory instruction because my friends are also with me in the field, were not inside the classroom to learned, it's a new experience and we are only the class section who are in the field to study."* (Participants12)

> *"I experience to learned outside the classroom and I've learned through that kind of teaching because I enjoyed in performing the activities."* (Participants 13)

> "*It is easy to understand the topic because of the demonstration and we are involved in performing the activity."* (Participants 14)

According to them, they learned from the conducted FBLI performances because it is hands-on (Participant 1), a new kind of teaching and it is fun (Participants 8 &10), it is a new experience to learn outside the classroom (Participants 12 &13), and easy to understand the topic (Participant 14). Students are hands-on because they experienced real life setting, instructional activities develop understanding through innovative way of teaching (Maxwellet al., 2018). Thus, it is suggested that Science Teachers should prepare activities align to Field-Based Laboratory.

Theme 2: Field-Based Laboratory Instruction is Good and Enjoyable

Participants' experiences using FBLI is found to be good and enjoyable, as presented in the following utterances:

> *"Field-based instruction is good sir because it is a different way of teaching because when we are in the classroom, I'm not used to listen but when we are in the field, I'm excited to listen to the discussion and I've learned a lot because my group mates show how to perform the activity."* (Participant 2)

> *"Field-based instruction sir is good; I don't get bored compared when we are inside the classroom."* (Participant 3)

> *"Field-based instruction is good because there are a lot of challenges just like biking a certain slant area to show conservation of mechanical energy."* (Participant 4)
> *"We're able to finish performing the activity in a short period of time and I really enjoy sir when we are in the field."* (Participant 5)

> *"I enjoy sir because in our activity we are using materials that are natural and present in the environment.*" (Participant 6)

> *"I enjoy the activity sir just like the topic regarding the causes of changes in momentum just like the impulse, the title of that activity sir is "Catch Me When I Fall.*" (Participant 7)

> *"I enjoy the Field-based instruction sir because the teaching in our school is inside the classroom. Field-based instruction sir, we're able to visit the entire locality of our barangay in performing the activity."* (Participant 9)

> *"My classmates are encouraged to go to school because they enjoyed the way it was taught, it's easy to learn because we are the one performing the activity."* (Participant 10)

> *"I enjoy field-based instruction because my friends are there also and everyone is cooperating with the instruction of our group leader and I am also excited because we will be in the field for our next meeting."* (Participant 11)

> *"I really enjoyed the Field base laboratory instruction because my friends are also with us in the field, were not in the classroom to discuss the topic but we are in the field, it's a new experience.* (Participants 12)
> *"Field-based laboratory instruction is exciting because of the activities and I experience to learned outside the classroom through that kind of teaching, because I enjoyed performing the activities."* (Participant 13)

> *"We enjoyed the teaching it's fun and exciting and it's easy to learn the topic because of the demonstration and we are involved*

in performing the activity." (Participant 14)

According to them, FLBI is good and enjoyable because it is a different way of teaching and they don't get bored (Participants 2 & 3) although there are a lot of challenges (Participant 4), the activities are finished in a certain time (Participant 5). The materials used are present in the environment (Participant 6), and it is easy to learn and everyone is cooperating (Participants 10 & 12) because it is exciting and fun (Participants 13 & 14). Field work is essential and enjoyable learning method as it develops skills, building group identity, team spirit and relationship and it also provides a deeper learning experience (Smith, 2020). Thus, it is recommended that science teachers must design activities that are suited to the learners need for them to enjoy teaching-learning process.

Theme 3: Involvement in FBLI is Exciting

From the participants' experience, involvement in FBLI is exciting. These are supported by their utterances presented below:

"I can able to answer the guide questions easily because I am involved in performing the activity too." (Participant 1)

"I'm excited to listen to the discussion and I've learned a lot because my group mates show how to perform the activity." (Participant 2)

"I'm excited sir for the next discussion on which place were going to visit and use to perform the activity, just like how we investigate the uniform accelerated motion on horizontal dimension in a certain slant area at the concrete river side to perform the activity." (Participant 6)

"My classmates are encouraged to go to school because the teaching is fun an it's easy to learn because we are involved, we are the one performing the activity." (Participant 10)

"I enjoy the field-based instruction because my friends are there also and everyone is cooperating with the instruction of our group leader and I am also excited because we will be in the field for our next meeting." (Participant 11)

"It's a new experience and we are only the class section who are in the field to learn. I'm also excited about the activities and to be in school always. (Participant 12)

"We enjoyed the teaching it's fun and exciting and it's easy to learn the topic because of the demonstration and we are involved in performing the activity" (Participant 14)

Involvement FBLI is exciting because they are the ones who perform activities (Participants 1, 6, & 10) and it is done in various places or fields (Participants 6 & 11). Outdoor instruction makes students more open to learning and excited about natural science (Technical University of Munich, 2018) and it makes students more engaged and interested (Kuo, 2019). Thus, exposing students to FBLI will boost their interest in science and will make them inspired in attending classes.

Field-Based Laboratory Instruction is an activity-oriented learning (from Theme 1), and student-centered (from Theme 3) because it is suited to learner's needs and enjoyable (from Themes 2 & 3).

4.3 Teacher's Experiences in Using Field-Based Laboratory Instruction

Presented in this portion is the self-narrative of the teacher who conducted the Field-Based Laboratory Instruction (FBLI). In his narration, most of his experiences are on the burden encountered using FBLI. In his first narration:

> *"Field-based instruction is a time-consuming way of teaching; one hour isn't enough to finish the lesson. Teacher must plan ahead of time to ensure smoothness of the delivery of the lesson. The instructional materials, daily lesson log (DLL), activity sheets and have an advance visit to the venue/place to be used in the delivery of the lesson to be familiar with and to ensure the safety of the students are those things that must be emphasis prior to the conduct of field-based instruction."*

In the afore-cited context, it is evident that the teacher is having difficulty on the lesson preparations especially as to the learning materials. Another thing to consider in using FBLI is the security of students during the conduct of activities. Field experiences require time, effort and an advance planning on both sides and it requires teacher to undergo extensive training before exposing into it but (Long, 2017). Thus, it is recommended that teacher must require more studies and initiatives that explore professional development that will enhance teacher's confidence and expertise in handle field teaching.

Another experience shared by the teacher is on,

> "*Field based laboratory instruction increased motivation and participation among the students it helps students develop their personal, social and scientific skills such as observation, measuring, inferring, predicting and experimenting. Challenges aroused on the conduct of field-based laboratory instruction such as, unpredicted weather that interrupts the delivery of the lesson, students are not comfortable in performing the activity during rainy day and it can be the reason to change and adjust the field setting arrangement just like bringing the discussion to covered court just carried out the activity"*

In the above cited text, it shows that the teacher has found a strategy that will encourage student's attendance and improve their performance in school. On the other hand, unpredictable weather aroused on the conduct of FBLI that caused interruption on the delivery of the lesson. Students that are involve in learning experience outside the classroom shows higher level of motivation, recall the course material clearly and improve academic performance in the class (Mcdaniel, 2020) but weather condition disturb human outdoor activity and this include extremely low or high temperature, rain wind or excessive heat and it is the responsibility of the facilitator in outdoor education to be prepared for such condition (Torkos, 2019). Thus, FBLI must be executed in a comfortable manner to make sure that students will benefit on this matter and to have a continues improvement in learning scientific.

Another experienced shared by the teacher is,

> *"Teacher must orient students prior to the conduct of field-based instruction to ensure everyone is cooperating. This teaching strategy is new to the students, misbehavior is being observe during the conduct of the FBLI. Orientation is also necessary to avoid the unnecessary things that may cause injury to the students*"

It was exposed in the above cited narrative that the classroom management must be strengthen on the conduct of FBLI and make sure that the safety of the students must be prioritized in conducting a field-based laboratory instruction, students must be aware of the do's and don'ts in the field to make sure the hundred percent achievement of the objectives. It is not surprising that classroom management is an issue in outdoor activity, this is unusual and innovative for most teacher and therefor distracting to the parts of the students because this is unfamiliar to them so they are subject to misbehavior (Ayotte-Beaudet et al., 2017). The safety of the students must consider in taking FBLI one of the most important steps in minimizing risk will be to undertake a site assessment of the outdoor learning area before taking students to this area to ensure the site is clear of hazards (Colaninno, 2020).

5. Conclusion and Recommendation

The use of field-based laboratory instruction improves students' performance on the topics of force, motion, and energy from not meeting expectations to being fairly satisfactory. Field-Based Laboratory Instruction provides learning through conducting actual or concrete activities. It is suited to junior high school learners because they found it good and enjoyable. Further, getting involved in the activities aligned with FBLI makes students excited to learn new things in a unique way. A well-planned field-based laboratory lesson delivers the lesson correctly; however, preparation of instructional materials and classroom management are also factors to consider. It is suggested that science teachers prepare activities that align with field-based laboratory instruction and design activities that are contextualized and suited to the learners' needs for them to enjoy the teaching-learning process.

6. Bibliography

Carnegie Mellon University. (2019). *Learning Objectives - Eberly Center - Carnegie Mellon University*. Cmu.edu. https://www.cmu.edu/teaching/designteach/design/learningobjectives.html

Colaninno, C. E., Lambert, S. P., Beahm, E. L., & Drexler, C. G. (2020). Creating and Supporting a Harassment- and Assault-Free Field School. *Advances in Archaeological Practice*, *8*(2), 111–122. https://doi.org/10.1017/aap.2020.8

Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and Mixed Methods Approaches* (5th ed.). SAGE Publications.

D'hondt, L. (2017). *Proper Planning Prevents Poor Performance*. Www.conundra.eu. https://www.conundra.eu/blog/proper-planning-prevents-poor-performance

Darling-Hammond, L., Flook, L., Cook-Harvey, C., Barron, B., & Osher, D. (2019). Implications for educational practice of the science of learning and development. *Applied Developmental Science*, *24*(2), 1–44. Tandfonline.

De Ramos-Samala, H. (2018). Spiral Progression Approach in Teaching Science: A Case Study. *KnE Social Sciences*, *3*(6), 555. https://doi.org/10.18502/kss.v3i6.2404

Department of Education. (2018). *PISA 2018 National Report of the Philippines*. https://bit.ly/3hBaoeC.

Dumo, J. (2019). *Regional Memoranda*. DepEd - Cordillera Administrative Region. https://www.depedcar.ph/regional-memoranda/rm-no-157-s-2019.

Feig, A. D., Atchison, C., Stokes, A., & Gilley, B. (2019). Achieving Inclusive Field-based Education: Results and Recommendations from an Accessible Geoscience Field Trip. *Journal of the Scholarship of Teaching and Learning*, *19*(2). https://doi.org/10.14434/josotl.v19i1.23455

Gomba, F. (2010). Involvement of civil engineering students in water resources projects: A field-based laboratory. *Asian Journal on Education and Learning*, *1*(1), 33–43.

Granger, E. M., Bevis, T. H., Saka, Y., Southerland, S. A., Sampson, V., & Tate, R. L. (2012). The Efficacy of Student-Centered Instruction in Supporting Science Learning. *Science*, *338*(6103), 105–108. https://doi.org/10.1126/science.1223709

Han, I. (2019). Immersive virtual field trips in education: A mixed-methods study on elementary students' presence and perceived learning. *British Journal of Educational Technology*, *51*(2). https://doi.org/10.1111/bjet.12842

Kinskey, M. (2018). Using action research to improve science teaching self-efficacy. *International Journal of Science Education*, *40*(15), 1795–1811. https://doi.org/10.1080/09500693.2018.1502898

Kinslow, A. T., Sadler, T. D., & Nguyen, H. T. (2018). Socio-scientific reasoning and environmental literacy in a field-based ecology class. *Environmental Education Research*, *25*(3), 388–410. https://doi.org/10.1080/13504622.2018.1442418

Kola, A. (2013). *Imperative of environment in science learning.* ResearchGate. https://www.researchgate.net/publication/263654368_Imperative_of_environment_in_science_learning

Kumar Shah, R. (2019). Effective Constructivist Teaching Learning in the Classroom. *Shanlax International Journal of Education*, *7*(4), 1–13. https://doi.org/10.34293/education.v7i4.600

Lemessa, A. (2017). Instructional Practices versus Application of Active

Learning Methods and Instructional Technology in Hawassa College of Teacher Education. *The Ethiopian Journal of Education*, *37*(1), 1–33. http://213.55.95.79/index.php/EJE/article/view/145

Maxwell, N., Hilaski, D., & Whelan-Kim, K. (2019). Enhancing Teacher Education through Field-Based Literacy Laboratories. *The Reading Professor*, *41*(1). https://scholar.stjohns.edu/thereadingprofessor/vol41/iss1/19

Mcdaniel, R. (2011, May 18). *Teaching Outside the Classroom*. Vanderbilt University; Vanderbilt University. https://cft.vanderbilt.edu/guides-sub-pages/teaching-outside-the-classroom/

Mustacisa, M. (2016). *Family Structure and Parental Involvement Vis-à-vis Science Performance of Grade 7 Students of Samar National School*. https://www.dlsu.edu.ph/wp-content/uploads/pdf/research/journals/mjs/MJS09-2016/volume-1/MJS09-4-mustacisa.pdf

Queens University. (n.d.). *Field-Based Learning |Centre for Teaching and Learning*. Retrieved 2021, from https://www.queensu.ca/ctl/resources/instructional-strategies/field-based-learning

Sontay, Gã., & KaramustafaoÄŸlu, O. (2018). THE EFFECT OF OUT-OF-SCHOOL SCIENCE LEARNING ENVIRONMENT ON THE UNDERSTANDING THE NATURE OF SCIENCE OF THE 7TH GRADE STUDENTS IN SECONDARY SCHOOL. *MOJES: Malaysian Online Journal of Educational Sciences*, *6*(4), 23–31. http://jice.um.edu.my/index.php/MOJES/article/view/13848

Torkos, H. (2019). *CEEOL - Home page*. Www.ceeol.com. https://www.ceeol.com/