



European
Commission

methods, tools and
materials for linguistic
and cultural sensitive
science teaching

for Science Teacher Education



ESTA
Educating Science
Teachers for All

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Need for Changes within the Project ESTA in Science Teacher Education at our University

Happier teachers would equate to more engaged students (Archer, 2017). Hence, SDG 4, which promotes quality education, stipulates the training and recruitment of quality teachers as essential to ensuring inclusive quality education (Nilsen & Gustafsson, 2016; Seebruck, 2015). The Philippines' elaboration of SDG 4's call for quality education emphasizes Talent Retention and Science Education specified in its country document, PAGTANAW 2050 (Rodil, 2021). As a priority area of PAGTANAW 2050, the country highlights plans and programs to address science teachers' poor qualifications and compensate for the loss of good science teachers who have gone abroad. Furthermore, statutory and regulatory requirements such as gender and inclusivity and desired teacher education program outcomes of the Philippine Commission on Higher Education dictate that Philippine universities such as PNU develop courses and programs in teacher education to address such requirements. Within this spectrum, the Philippine Normal University, as the National Center for Teacher Education, engages in capability, capacity building, and retooling of its University Science Educators through the ESTA program to better enact science teacher education programs for more inclusive science education.

Educating Science Teachers for All (ESTA) is an international program for the capability and capacity building of science teachers in countries where a plurality of languages and cultures exist and science education occurs amidst political or ethnic divides that translate into linguistic heterogeneity and cultural diversity. The aim of ESTA in PNU, as one of the partner countries and institutions, is to improve the level of competencies in the institution through the professionalization and development of university science educators regarding diversity in science classes, particularly in linguistic and cultural aspects. In turn, upskilled/reskilled university science educators can enact inclusive science education for pre-service and in-service science students and teachers. Such a program will be able to ensure that Filipino learners will benefit from an inclusive science education where diversity matters and is considered a resource in the teaching and learning process.



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Collection of Methods, Tools and Instruments from the University of Limerick and Ludwigsburg University of Education

Methods, Tools and Instruments for dealing with linguistic diversity and cultural diversity

The entire project consisted of several phases over its four years of implementation. A year's extension was granted due to the pandemic; the project is expected to be completed on January 14, 2024.

Preparation

Kick Off Meeting

To jumpstart the project, the preparation phase included several processes. A preparatory phase accommodated a kick-off meeting held in Germany on February 17-18, 2020, at Ludwigsburg University. The significant items discussed in the Kick-Off meeting were the following: 1) background of the study; 2) research goals; 3) work packages; 4) organization of the project; 5) financial management; 6) dissemination plans; 7) communication plans; and 8) further planning by partner countries. The event was concluded with feedback from an external evaluator.

Local Kick-Off Meeting

A similar activity was carried out at the Philippine Normal University to initiate all other ESTA-PNU activities. However, the local Kick-Off meeting was done virtually due to restrictions on physical gatherings because of the pandemic (COVID-19). This local Kick Off meeting also acquainted the members of the ESTA-PNU team with the following: 1) background of the study; 2) research goals; 3) work packages; 4) organization of the project; 5) financial management; 6) dissemination plans; and 7) communication plans. After a week-long Kick-Off meeting and workshop, the ESTA-PNU team was able to accomplish the following: 1) Terms of Reference for each member and groupings within ESTA-PNU; 2) a detailed TOR based on Work Packages vis-à-vis specific groups (Manager, Teacher-Trainer, Researcher, Technical Staff, and administrative staff); 3) a detailed method per work package; and 4) detailed information for the conduct of the project.

Development of ESTA-PNU Framework (Science Education for Linguistic and Cultural Diversity in Philippine Higher Education [SELC-PhPHEid])

The team members thoroughly documented the development process in *Going Inclusive: A Framework for Science Inclusivity in Teacher Education*. A design and development research design was implemented to develop the ESTA-PNU framework, covering the following processes: 1) a literature survey to come up with the concepts and themes that later evolved into the framework; 2) Framework development by the team, which included features, principles, and design of the framework; 3) framework critiquing by the team of researchers composed of experts in Science Education, Biology, Chemistry, Biochemistry, Physics, Language and Literature, and Social anthropology; and 4) refinement of the draft framework by the same team.



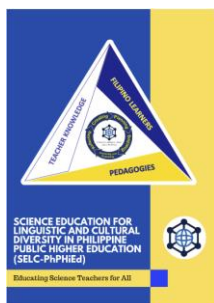
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Validation of ESTA-PNU Framework (Science Education for Linguistic and Cultural Diversity in Philippine Higher Education [SELC-PhPHEid])

The framework validation included FGDs with experts, the development of a framework integration model, the development of LE templates, and the development and validation of sample LEs per cluster of courses. These LEs were likewise subjected to language and culture integration validation by experts.

The FGD was directed by the following questions to gather the views of experts on the draft framework: (1) What is your aspiration/vision for science teachers to achieve science education for all? (2) What can you say about the features/ principles/ assumptions of this ESTAPHIL Framework? (3) What other features/ principles/ assumptions will you include if you design an inclusive science education program for teachers? The FGD participants were selected based on their area of expertise, sectoral representation (basic and tertiary education, faculty, graduate students, and researchers), and geographical location. The fourteen participants who validated the framework included three (3) students taking PhDs in Science Education, five (5) experts in Science and Language from private higher education institutions (HEIs), two (2) science specialists from the basic education sector, and four (4) science and language specialists from public HEIs in the country from Manila, North Luzon, South Luzon, Visayas, and Mindanao. The data collected from the FGD were then transcribed, coded, and analyzed manually. New constructs were mapped out from the data and became part of the revised and newly developed ESTA Framework.

After implementing all inputs from the FGD, a revised version of the framework was used to develop the following for the 2nd tier validation. First, the protocol for integrating the framework into the science programs of the teacher education curriculum was crafted. Courses in the undergraduate science programs (physics, chemistry, and biology) were clustered as specialization courses and courses on teaching and learning. In contrast, courses in the graduate programs were clustered as core courses (philosophy and research courses) and specialization courses. The common attributes of the cluster of courses were coded, to which the framework may apply. Specifically, the detailed integration of the framework was indicated in the Lesson Exemplars (LEs) of the sample courses in the identified clusters and programs. Second, the content specialists developed a template for the LEs and samples anchored in the revised framework. Finally, sequential validations were also evident in the entire development process. Such a process included piloting the LE templates by science educators in teacher education programs and science teachers in primary education in the Philippines. Further validation was sought using their inputs in an open survey form, which focused on the alignment of LEs to the framework, the ease or difficulty of using the LEs, and the benefits they can derive if they use the LEs in their teaching and learning processes.



The developed ESTA-PNU framework may be accessed through the QR code. The framework for Science Education for Linguistic and Cultural Diversity in Philippine Public Higher Education (SELC-PhPHiEd) is visualized to encompass three major components: the Filipino learners, the pedagogies and pedagogical frameworks, and the teachers' knowledge system in terms of enacting the science curriculum. SELC-PhPHiEd presents the general constructs of focus in undertaking

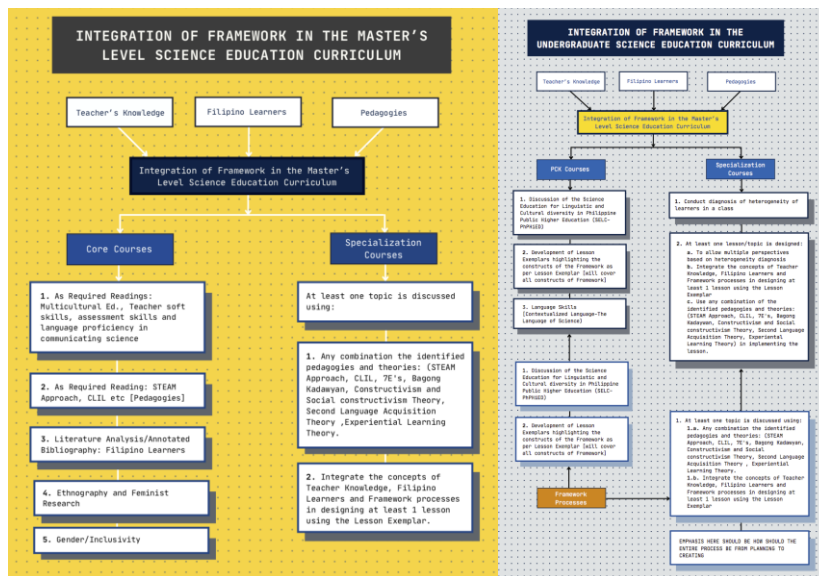
curricular modifications, enhancements, and enactment. These general constructs outline how the blueprint may also inform the different teacher education processes that inform teacher's knowledge, training, and research in pedagogies and the development of products for teaching and learning, such as Lesson Exemplars, modules, and assessment within the bounds of linguistic and cultural inclusivity. SELC-PhPHiEd is PNU's vehicle to concretely advocate the transfer of technology and disseminate knowledge

on linguistic and cultural inclusivity to other Teacher Education Institutions for higher-quality science education in the country.

Development

Revision of Courses

For ESTA-PNU, the SELC-PhPHiEd framework guided the revision of courses. First, all courses (for in-service programs-graduate classes) were clustered as specialization or core courses. From the clustering, the team identified (using matrices) how each framework construct may be integrated into the core and specialization courses. The exact process was followed in the undergraduate courses (pre-service courses). The team clustered the pre-service courses into PCK courses and specialization courses.



Matrices were also utilized to integrate the framework constructs into the group of courses in the pre-service. An integration model was constructed after a series of presentations and critiques of the integration matrices, as shown in Figure 2. Both integration models define the development of Lesson Exemplars using framework-guided templates. The QR code below directs to the Lesson Exemplar template and the accompanying rubric.



The Lesson Exemplar Template is a product derived from the ESTA-Phil-PNU Framework: Science Education for Linguistic and Cultural Diversity in Philippine Higher Education (SELC-PhPHiEd) that transitions that framework into a usable product for teachers. It aims to codify the framework to help teachers craft meaningful lessons for Filipino learners who are culturally and linguistically diverse. The template comes with a Rubric to establish quality before, during, and after the development of Lesson Exemplars.

List of Courses that were Enhanced using the ESTA-PNU Integration Models

Below is the list of enhanced courses on the extent of the introduction of sensitization to heterogeneity and diversity following the pathways directed by the integration models:



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| GRADUATE COURSES | | | | 15 courses |
|-------------------------------|---|---|---|------------|
| | MASEd (Bio) | MASEd (Physics) | MASEd (Chemistry) | |
| CORE COURSES | Quantitative Research Method | Quantitative Research Method | Quantitative Research Method | |
| | Qualitative Research Method | Qualitative Research Method | Qualitative Research Method | |
| SPECIALIZATION COURSES | Contemporary Issues and Perspectives in Science Education | Contemporary Issues and Perspectives in Science Education | Contemporary Issues and Perspectives in Science Education | |
| | Curriculum, Instruction and Assessment in Science Teaching | Curriculum, Instruction and Assessment in Science Teaching | Curriculum, Instruction and Assessment in Science Teaching | |
| | Environmental Science | Environmental Science | Environmental Science | |
| | Molecular Biology | Classical Physics | Advanced Inorganic Chemistry | |
| | Biotechnology | Thermodynamics | Reaction and Mechanism in Organic Chemistry | |
| | Aquatic Biology | Electromagnetism | Physical Chemistry | |
| UNDERGRADUATE COURSES | | | | 21 courses |
| | BSE (Bio) | BSE (Physics) | BSE (Chemistry) | |
| English Course | Purpose Communication | Purpose Communication | Purpose Communication | |
| PCK COURSES | Student Understanding and Metacognition in Learning Science | Student Understanding and Metacognition in Learning Science | Student Understanding and Metacognition in Learning Science | |
| | Integrated Approaches and Technology in Science Teaching | Integrated Approaches and Technology in Science Teaching | Integrated Approaches and Technology in Science Teaching | |
| | Dimensions and Standards of Assessment in Science Education | Dimensions and Standards of Assessment in Science Education | Dimensions and Standards of Assessment in Science Education | |
| SPECIALIZATION COURSES | General Botany (4) | Fundamentals of Physics (Mech & Thermo-4) | Inorganic Chemistry 1 (3) | |
| | General Zoology (4) | Electromagnetic Theory 1 (3) | Organic Chemistry (4) | |
| | Human Anatomy and Physiology (4) | Waves and Optics (4) | Analytic Chemistry (4) | |
| | Organic Chemistry with Biochemistry (4) | Electromagnetic Theory 2 (3) | Biochemistry (4) | |
| | Genetics, Evolution and Biotechnology (4) | | Physical Chemistry (3) | |
| | Ecology and Fieldwork (4) | | Natural Product and Toxicology (3) | |
| | | | Materials and Industrial Chemistry (3) | |

Development of Training Design for University Science Educators and Basic Science Teachers in the Philippines

During the framework development, the team conducted several “Echo Workshops” within the ESTA-PNU group to determine how to adapt/adopt the materials and resources of ESTA. Table 1 presents the Echo Workshops of Academic Staff Tours, conducted online via Zoom.

Table 1

Echo of Academic Staff Tour

| Workshop No. | Workshop Title | Date | Facilitator |
|--------------|--|-----------------|-------------------------------|
| 1 | Planning my Teaching | October 1, 2020 | Marie Paz Morales |
| 2 | Language and Science Education, Part 1 | October 1, 2020 | Ruth Alido, Marie Paz Morales |
| 3 | Language and Science Education, Part 2 | January 5, 2021 | Ruth Alido, Marie Paz Morales |
| 4 | Interest and Science Education | January 5, 2021 | Alfons Jayson Pelgone |



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| | | | |
|---|-------------------------------|-------------------|-------------------------------------|
| 5 | Culture and Science Education | March 25, 2021 | Arlyne Marasigan, Crist John Pastor |
| 6 | Flipped Classroom Part 1 | July 28, 2021 | Sylvija Markic |
| 7 | Flipped Classroom Part 2 | September 6, 2021 | Ruel Avilla |

As soon as the echo workshops were completed, the team presented the framework and its products to the policymakers of the institution for the adoption of the framework and all ESTA-PNU products as official documents of the University (PNU). Upon approval, the team designed the Training Design for University Science Educators and Basic Science teachers, guided by the SELC-PhPHiEd framework. Table 2 presents the phases of the training design mapped against the constructs of the aforementioned framework. Figure 3 presents the complete training design for the University Science Educators and Basic Science Teachers.

Table 2

SELC-PhPHiEd Framework in the Training Design

| SELC-PhPHiEd Framework Constructs | Training Design Sections |
|---------------------------------------|---|
| Filipino Science Teachers' Competence | Phase 1: Plenary Sessions <ul style="list-style-type: none"> • Science Education Program in the Philippines • Language for Sciences • Concepts of Contextualization |
| Pedagogies | Phase 1: Plenary Sessions <ul style="list-style-type: none"> • Contextualization and localization, • use of the multilingual medium Phase 2: Mentoring <ul style="list-style-type: none"> • inclusion of the following learning principles and theories: <ul style="list-style-type: none"> ○ STEAM approach ○ <i>Bagong Kadanyan</i> ○ constructivism and social constructivism theory ○ second language acquisition ○ experiential learning theories |
| Filipino Learners | Phase 1: Academic Staff Tour (AST) |

Figure 1
Training Design



Pilot Testing of the Training Design of the Graduate Students

Table 3 shows the summary of the responses of the teacher-participants in the pilot testing of the Lesson Exemplar template via an open survey.

Table 3.
Summary of Responses of Teacher-Participants on their Utilization of the Lesson Exemplar Template via Open Survey

| Constructs/ items in open survey | Participant Responses |
|--|--|
| Best or most effective parts of the lesson exemplar template | <ul style="list-style-type: none"> ● Teacher Knowledge ● Explicit inclusion of contextualization principles for language and culture ● Highlights on technological use and support ● Reflection section, which is filled out after the lesson is implemented |
| Parts that needed improvement | <ul style="list-style-type: none"> ● The tabular structure where the information will be explicitly supplied on the assessments ● Examples should be provided in the cognitive and skills section |



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| | |
|-------------------------|---|
| | <ul style="list-style-type: none">• The STEAM multidisciplinary section should be clarified further |
| Difficult to accomplish | <ul style="list-style-type: none">• Pedagogies section• Assessment section |

The participants believe the LE templates can help them plan for inclusive learning of science concepts. The emphasis on contextualization with culture and language shows how teachers develop depth in teaching using inclusive pedagogy by considering the students' cultural and language backgrounds. Such a premise on inclusive pedagogy highlights student voices that foster inclusive teaching and student environments. The teachers themselves can reflect while planning their lessons and have expressed interest in adopting the template in their communities of practice. The participants claim that the lesson exemplar template may improve teaching and learning.

The participants claim that the lesson exemplar template may improve teaching and learning. One of its best features is that it gives a whole perspective on the progression of the lesson that impacts the facilitating skills, the art of questioning, and even the students' responses. The LE template is optimized, thus providing confidence and readiness to deliver the lesson effectively. These attributes of teachers using the LE templates match teacher quality that helps ensure and impact the country's science education quality.

Midterm Report

All the above information is consolidated to complete the midterm report for ESTA-PNU and submitted to the Project Management Board for further synthesis and consolidation with the reports of other ESTA partners for submission to the funding agency. Incidentally, the project was granted a year extension to complete all declared goals and objectives. This request was initiated because of the non-physical meetings that hindered a lot of intercultural learning that may happen during academic staff tours and consortium meetings.



Implementation

Training Participants

Table 4

Participant Profile (Basic Education Science Teachers)

| Characteristics | Phase 1 (n = 808) f(%) | Phase 2 (n = 99) f(%) |
|----------------------------------|---------------------------|--------------------------|
| Gender | | |
| • Female | 540 (66.8) | 63 (62.37) |
| • Male | 260 (32.17) | 33 (33.33) |
| • Non-binary | 8 (1%) | 3 (2.97) |
| Teaching Area | | |
| • Science | 720 (89.11) | 99 (100) |
| • Mathematics | 46 (5.69) | |
| • Others (e.g., STEM) | 42 (5.2) | |
| Grade level assignment | | |
| • Primary and elementary school | 122 (15.1) | 12 (12.12) |
| • High school/senior high school | 390 (48.27) | 87 (87.87) |
| • Tertiary level | 270 (33.42) | |
| Academic Rank | | |
| • Teacher 1-3 | 708 (87.62) | 81 (81.81) |
| • Master Teacher | 79 (9.78) | 15 (15.15) |
| • Department heads | 9 (1.11) | 3 (3.03) |



Table 5

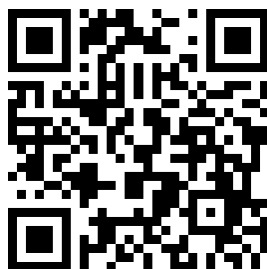
Participant Profile (Pre-Service Science Education Students)

| Profile | Frequency | Percentage |
|--------------------------------|-----------|------------|
| Age | | |
| Above 30 | 1 | 0.31% |
| 25-30 | 2 | 0.62% |
| 20-25 | 217 | 66.77% |
| 15-20 | 105 | 32.31% |
| Sex | | |
| Male | 104 | 32.00% |
| Female | 221 | 68.00% |
| Gender identity | | |
| Male | 97 | 29.85% |
| Female | 220 | 67.69% |
| Non-binary | 8 | 2.46% |
| Mother tongue | | |
| Filipino | 210 | 64.62% |
| English | 3 | 0.92% |
| Other dialects | 112 | 34.46% |
| Language spoken at home | | |
| Filipino | 210 | 64.62% |
| Dialect | 112 | 34.46% |
| English | 3 | 0.92% |
| Geography (Regions) | | |
| I | 36 | 11.08% |
| IV-A | 23 | 7.08% |
| IV-B | 16 | 4.92% |
| VII | 34 | 10.46% |
| VIII | 25 | 7.69% |
| X | 12 | 3.69% |
| NCR | 117 | 36.00% |

| Profile | Frequency | Percentage |
|---|-----------|------------|
| None | 222 | 68.31% |
| With training attended | 103 | 31.69% |
| covered in a lecture/seminar | 120 | 36.92% |
| module on topic | 86 | 26.46% |
| covered over multiple lectures/seminars | 119 | 36.62% |
| covered in a lecture/seminar | 130 | 40.00% |
| module on topic | 151 | 46.46% |
| covered over multiple lectures/seminars | 44 | 13.54% |
| Special Needs | | |
| covered in a lecture/seminar | 112 | 34.46% |
| module on topic | 105 | 32.31% |
| covered over multiple lectures/seminars | 108 | 33.33% |

| Profile | Frequency | Percentage |
|-------------------|-----------|------------|
| Year Level | | |
| Fourth Year | 103 | 31.69% |
| Third Year | 114 | 35.07% |
| Second Year | 69 | 21.23% |
| First Year | 1 | 0.30% |
| Graduate | 2 | 0.62% |

Conduct of Training for University Science Educators



The entire documentation of implementing the training design for the University Science Educators is captured in Technical Report 1, prepared by the ESTA-PNU team, which may be accessed through the QR code. This training was implemented from February to March 2022.

Conduct of Training for Basic Education Science Teachers and Science Teachers at the Tertiary Level (Luzon and Visayas)

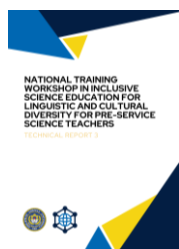


The entire documentation of the implementation of the training design for the Basic Education Science Teachers and Science Teachers in the Tertiary Level (Luzon and Visayas) is captured in the Technical Report 2 prepared by the ESTA-PNU team, which may be accessed through the QR code. This training was implemented from July to September 2022.



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Conduct of Training for Pre-Service Science Teachers in the Philippine State Universities and Colleges



The entire documentation of the implementation of the National Training Workshop in Inclusive Education for Linguistic and Cultural Diversity for Pre-Service Science Teachers is captured in the Technical Report 3 prepared by the ESTA-PNU team, which may be accessed through the QR code. This training was implemented from September to November 2023.

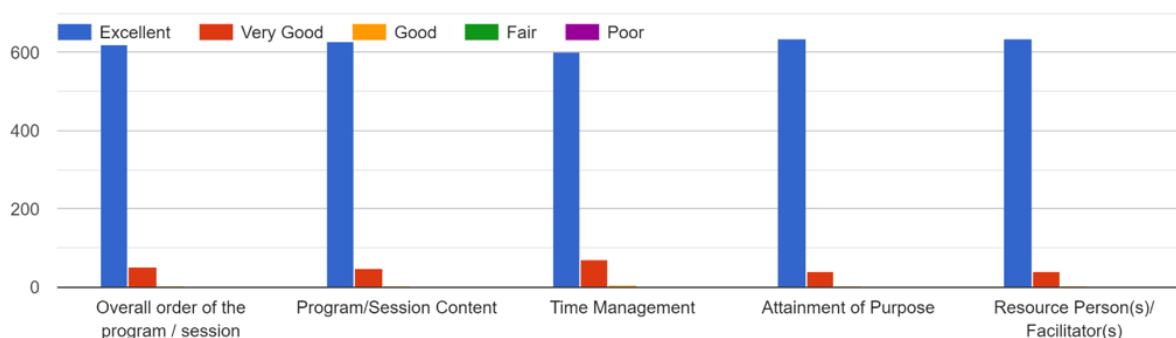
Quality

Evaluation by the Participants of the Basic Education and Tertiary Education Science Teachers Training

The team conducted a two-phased evaluation to determine the importance of the training in developing inclusive science education. The first evaluation comprises two parts that determine teacher participants' ratings of the training workshop regarding different constructs, their learning, how they can benefit from the training, and some comments and suggestions (Figure 2).

Figure 2

Teacher-participants Rating of the Training Workshop



As gleaned from Figure 2, the teacher-participants rated all training constructs within the range of very good to excellent, with a large percentage of ratings being on the excellent rating. This result means that the participants perceive the training as beneficial to their teaching-learning process.

The second part of the phase 1 evaluation focused on the three open-survey questions presented in Table 6.

Furthermore, Table 6 is an abstraction process to show the summary of themes derived from a thematic analysis of the participants' responses.

**Table 6***Thematization of Training Evaluation*

| Question | Codes | Category | Themes |
|---|--|---|--|
| Question 1: What have I learned most from this program/session? | Diversity in Class | sensitization to heterogeneity and diversity | Sensitization and actions to address heterogeneity and diversity |
| | Socio-economic, cultural, and language backgrounds of learners | | |
| | Cultural diversity | Actions to address diversity and heterogeneity in class | |
| | Development of Lesson Exemplars | | |
| | Hook videos | | |
| | Language for Science | | |
| | Teacher quality | | |
| | Flipped classroom | | |
| Contextualization, Indigenization, and Localization | | | |
| ESTA experiences | | | |
| Technology integration | | | |
| Question 2: What aspects of the training can I use in my class to address class heterogeneity and diversity? | Development of Lesson Exemplar | Inputs, tools, approaches, and strategies | Principles, Tools, strategies, and competencies to address class heterogeneity and Diversity |
| | Hook videos | | |
| | Contextualization, Indigenization, and Localization | | |
| | Diversity in class | | |
| | Language for Science | Teacher competencies about addressing heterogeneity and diversity | |
| | Science Capital | | |
| | Technology integration | | |
| | Cultural background | | |
| | Cultural diversity | | |
| | Flipped Classroom | | |
| Teacher quality | | | |
| Science/Teacher Education | | | |
| Question 3: How can I utilize or implement what I have learned about culture and language integration in my field/practice? | Preservation of culture and language | Workshop takeaways are valuable to participants | Knowledge transmission and application to address heterogeneity and diversity in class |
| | Socio-economic, cultural and language backgrounds of learners | | |
| | Diagnosing learners | Process of disseminating knowledge learned | |
| | Development of Lesson Exemplars | | |
| | Hook videos | | |
| | Science Capital | | |
| | Language for Science | | |
| | Integration of Sensitization in class | | |
| | Technology Integration | | |
| | Sharing and dissemination of practices and knowledge learned | | |

Phase 2 Evaluation was conducted as a pre-and post-training evaluation using the instrument developed by Limerick and Ludwigsburg. Below are the detailed accounts of the pre-training and post-training evaluations.

Pre-Training Responses

Participants' ages range from 24-50 years old, dominated by females (63.2%), while males account for 36.1%, and 1% are non-binary. The majority declared that their mother tongue is Filipino (73.7%), while others speak of other regional dialects (33.3%), which include Kapampangan, Bisaya, Bicol, Hiligaynon, Cebuano-Visaya, Ilokano, Pangasinan, and Iloko.

Regarding the teaching profession, 33.8% and 33.1% account for teachers in the lower and higher secondary levels, 15.8% are at the elementary level, and 22.6% are teaching tertiary-level science. These participants also claim to have



diverse science classes. About 15% of these participants do have students with special needs in their science classes; 80.5% of these participants declare to deal with students with different achievement levels; 50.4% profess to teach students with different learning conditions; 37.6% with different cultures; and 15.8% claim to have students who do not speak Filipino as their mother tongue.

Table 7 presents the percentage of participants who perceived and reported that heterogeneity, cultural diversity, and special needs are integrated into the Teacher Education Program. Based on Table 5, many participants claim that cultural diversity is integrated into their Teacher Education Program in almost all identified media. This result may be attributed to the distribution of participants with varied regional dialects spoken, which goes with their cultural background.

Table 7
Coverage/Inclusion of CLD in Teacher Education Program

| Topic | Medium of Inclusion in Teacher Education Program (% of participants) | | |
|--------------------------|--|------------------------------|---|
| | Module on Topic | Covered in a Lecture/Seminar | Covered over Multiple Lectures/Seminars |
| Linguistic Heterogeneity | 19.7 | 11.40 | 18.18 |
| Cultural Diversity | 65.9 | 65.15 | 59.00 |
| Special Needs | 15.0 | 24.24 | 23.50 |

Table 8
Participants' Opinion on Working with CLD

| Items | SA (%) | A (%) | N (%) | D (%) | SD (%) |
|---|--------|-------|-------|-------|--------|
| Adequacy of training to work with CLD | 9 | 55 | 19.7 | 15.15 | 1.5 |
| Interest in receiving more training in working with CLD students | 61.4 | 34.8 | 3.7 | 0 | 0 |
| Preparedness to integrate multicultural content into the curriculum | 25.7 | 49.2 | 20.45 | 4.5 | 0.75 |
| Preparedness to teach using different multicultural perspectives | 24.24 | 47 | 22.7 | 6 | 0.75 |
| Preparedness to adjust teaching to cater for different learning styles to meet the individual needs of the students | 35.6 | 55.3 | 7.5 | 2.23 | 0.0 |

SA-Strongly Agree, A-Agree, N-Neutral, D-Disagree, SD-Strongly Disagree

Table 8 presents participants' opinions in relation to working with CLD students. The majority of the participants agree that they have received adequate training. They also claim they are prepared to integrate multicultural content and teach different multicultural perspectives, as confirmed by integrating cultural diversity in varied media in their teacher education program (see Table 5). Despite this condition, most participants show interest in receiving more training in working with CLD students. They are willing to adjust their teaching to cater to the differing needs of learners with different learning styles.



Post-Training Responses

Table 9 presents phase 2 of the evaluation conducted six months after the training.

Table 9

Phase 2 Training Evaluation

| Item Constructs | SA (%) | A (%) | N (%) | D (%) | SD (%) |
|--|--------|-------|-------|-------|--------|
| Student Background, Diagnosis, and Learner-Focused | 43.78 | 34.81 | 11.26 | 6.52 | 4.52 |
| Teachers' competence and skills | 36.28 | 38.33 | 15.07 | 7.75 | 2.57 |
| Pedagogy-related Items | 44.50 | 35.14 | 11.23 | 5.89 | 3.24 |

SA-Strongly Agree, A-Agree, N-Neutral, D-Disagree, SD-Strongly Disagree

Table 10

Phase 2 Training Evaluation Summary of Verbatim Responses

| Questions | Summary of Verbatim Responses |
|--|---|
| Was there anything you particularly liked about the course? | Sensitization and Diagnosing Learners Localization, Contextualization, Indigenouization, Addressing CLD |
| What suggestions do you have for further course development? | Learning area integration More training and F2F workshop Instructional Materials and Tools development Strategies to address CLD |
| What is your take-home message? | The essence of learner-centered teaching Teachers' role in addressing CLD Sensitization and CLD |
| Is there anything you'd like to try to implement in your classroom? How? | Activities in ESTA training Activities/lesson based on students' needs, language, and culture Hook videos Use of language prompts Localized teaching materials Diagnosis and Sensitization Lesson Exemplar/ ESTA-PNU type Lesson Exemplar |

Table 10 shows summarized results generated from a majority agreement of participants in the three item constructs, which are also the featured constructs of the grounding framework (SELC-PhPHiEd) of the training program: Filipino learners, pedagogies, and teachers knowledge. This result is consistent with the participants' summarized verbatim (Table 11) responses, which also feature the same constructs. Note that only the pedagogies constructed emphasize using instructional materials such as Lesson exemplars and hook videos to address CLD.



The evaluation/feedback from the participants in this training informs the development of materials, specifically the development of Hook Videos and Lesson exemplars. Through the revised guidelines, the participants included their mother tongue as the conversational aspect of the videos, which were subtitled in English. Lesson Exemplars were also improved through the use of simple learning activities highlighting active and hands-on learning, even if the country sustained its school closures during this period of implementation.

Table 11
Science Capital Dimensions in the Developed Lesson Exemplars

| Lesson Exemplars (LE) and Hook Videos (HV) | Science Capital Dimensions | | | | | | | |
|---|----------------------------|----|----|----|----|----|----|----|
| | D1 | D2 | D3 | D4 | D5 | D6 | D7 | D8 |
| LE1: Homogeneous and heterogeneous mixture [Grade 6] | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ |
| LE2: Special Properties of Matter [Grade 4] | ✓ | ✓ | ✓ | | ✓ | ✓ | | ✓ |
| LE3: <i>Ang Kapalalitan at Kahalagahan ng Tao at Iba pang May Bukay</i> (The Environment and its Value for Living Things) [Grade 3] | ✓ | ✓ | | ✓ | ✓ | | | ✓ |
| LE4: Reproductive System [Grade 10] | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | |
| LE5: Unifying Themes in the Study of Life [Grade 11] | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| LE6: The occurrence of solar and lunar eclipses [Grade 7] | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| LE7: Types and Ingredients of Personal Care Products [Grade 12] | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

D1-scientific literacy, D2-science-related attitudes, values, and dispositions, D3-knowledge about the transferability of science, D4-science media consumption, D5-participation in out-of-school science learning contexts, D6-family science skills, knowledge, and qualifications, D7-knowing people in science-related roles, D8- talking about science in everyday life with key people in their lives, such as friends, siblings, parents, neighbors, and community members.

Table 12
Science Capital Dimensions in the Developed Hook Videos

| Hook Videos (HV) | Science Capital Dimensions | | | | | | | |
|---|----------------------------|----|----|----|----|----|----|----|
| | D1 | D2 | D3 | D4 | D5 | D6 | D7 | D8 |
| HV1: The Balloon and Water Trick | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ |
| HV2: Boyle's Law | ✓ | ✓ | | ✓ | ✓ | ✓ | | ✓ |
| HV3: Boyle's Law | ✓ | ✓ | ✓ | ✓ | ✓ | | | ✓ |
| HV4: Breathing and Pulse Rate Relationship | ✓ | ✓ | | ✓ | | ✓ | | ✓ |
| HV5: Cell Division | ✓ | | | ✓ | | ✓ | | ✓ |
| HV6: The Coin Experiment | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ |
| HV7: Conduction | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ |
| HV8: Heterogenous and Homogeneous Mixtures | ✓ | ✓ | | ✓ | ✓ | | | ✓ |
| HV9: Intermolecular Forces of Attraction | ✓ | ✓ | | ✓ | ✓ | ✓ | | ✓ |
| HV10: Law of Inertia | ✓ | ✓ | | ✓ | ✓ | ✓ | | ✓ |
| HV11: Now you know | ✓ | ✓ | | ✓ | ✓ | ✓ | | ✓ |
| HV12: Second Law of Motion | ✓ | ✓ | | ✓ | ✓ | | | ✓ |
| HV13: Types and Ingredients of Personal Care Products | ✓ | ✓ | | ✓ | ✓ | | | |
| HV14: What If | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ |

D1-scientific literacy, D2-science-related attitudes, values, and dispositions, D3-knowledge about the transferability of science, D4-science media consumption, D5-participation in out-of-school science learning contexts, D6-family science skills, knowledge, and qualifications, D7-knowing people in science-related roles, D8- talking about science in everyday life with key people in their lives, such as friends, siblings, parents, neighbors, and community members.

Tables 11 and 12 show that the lesson exemplars and hook videos exhibited seven to eight science capital dimensions. However, most lesson exemplars for elementary learners need to include the development of the seventh science capital dimension (*knowing people in science-related roles*). Contrastingly, lessons for high school exhibited the capabilities of the teacher-participant to include the aforementioned dimension. Similarly, the developers of the hook videos did not include this dimension in their videos to sustain the three-minute maximum allowable for a hook video. In most LEs, the teacher-participants used a KWL (What I Know, What I Want to Learn, What I Learned) chart, experiments



or activities, and discussions of their topics to develop scientific literacy. Most participants create venues for applying concepts the students learn in other fields. They sometimes integrate family science skills, knowledge, and qualifications (e.g., consultation with mothers and siblings on cosmetics).

Additionally, they commonly use video clips and software for science media consumption. They cultivate science-related attitudes, values, and dispositions through reflection and incorporate values and scientific attitudes into activities in the lesson exemplars. However, participation in out-of-school science is limited to conversations with siblings and parents at the elementary level and interviews and surveys for older learners.

Developing hook videos and incorporating these HVs in teaching and learning indicates science media consumption (dimension 3). In the developed hook videos, participants assimilated the development of scientific literacy through the predict-observe-explain (POE) strategy, the use of pre-and post-experiment videos, and the design of explainer videos, in which they also merged the development of science-related attitudes, values, and dispositions (through reminders and precautions). Due to the three-minute limit for the HVs and to the purpose of the hook video as a short engagement, only four of the 14 HVs showcased the following dimensions: 3 (*knowledge of transferability*), 5 (*participation in out-of-school science learning contexts*), and 7 (*knowing people in science-related roles*). The hook videos (HV) only cover dimension 8 (as shown in Tables 11 and 12), and dimension 6 (family science skills, knowledge, and qualifications) is introduced through the use of the learners' mother tongue or first language in these videos. It may be noted that optimal attainment of the eight science capital dimensions may be possible when HVs are integrated into lessons.

Evaluation by the Participants of the Pre-Service Science Teachers Training

Effect of customized pre-service teacher training on inclusive science education for linguistic and cultural diversity in terms of

1. Teachers' Attitudes towards Valuing Students' Culture and Languages
2. Teachers' Expectations of CLD Students' Academic Performance
3. Negative Attitudes Towards Inclusion of CLD Students in Subject Area Classes
4. Positive Attitude towards Inclusion of CLD Students in Subject Area Classes
5. Teachers' Beliefs about CLD Students Enrolled in their Subject Area Classes
6. Teachers' Attitudes towards CLD Students' Needs

Table 13

Effect of Customized Pre-Service Teacher Training on Inclusive Science Education for Linguistic And Cultural Diversity

| No. | Constructs | Chi-square value | df | p-value | Cramer's V |
|-----|---|------------------|----|----------------|---------------------------|
| | Teachers' Attitudes towards Valuing Students' Culture and Languages | 23.24 | 4 | .000112873613* | .08755353126 ^a |
| 1 | Knowing the background and experiences of culturally and linguistically diverse (CLD) students substantially impacts their learning performance. | 11.92 | 2 | .002570631862* | .1663530413 ^a |
| 2 | Every student in my class is a unique combination of his/her cultural background, language, home, and experiences. | 6.03 | 1 | .01408142079* | .1181248846 ^a |
| 3 | My students' identities bring richness to my classroom through language and culture. | 9.68 | 2 | .00790845218* | .1498618574 ^a |
| 4R | CLD students should be encouraged to modify their behavior to adapt to the mainstream culture. | 6.09 | 2 | .04748708537* | .1182304058 ^a |
| 5 | My own culture influences my understanding of students. | 2.21 | 2 | .330398528411 | .07127462366 ^a |
| 6 | Science teachers should respect and value CLD students' primary languages and dialects. | 12.00 | 2 | .002477798199* | .1664794398 ^a |
| 7 | The science teachers are responsible for utilizing students' first languages and dialects as vehicles for helping CLD students to learn standard English. | 3.44 | 2 | .17915316158 | .0890170125 ^a |
| | Teachers' Expectations of CLD Students' Academic Performance | 12.32 | 4 | .015102847547* | .0752199485 ^a |
| 8 | The more I expect from CLD students academically, the more they are likely to achieve. | 9.25 | 2 | .009792561158* | .1456735739 ^a |
| 9 | I expect all students in my science classes can and do have the potential to learn regardless of their diverse cultures or languages. | 16.25 | 2 | .000296649525* | .1934760749 ^a |



| | | | | | |
|--|--|-------|---|----------------|---------------------------|
| 10R | Students who don't put forth enough effort usually fail in my science class; likewise, students who work hard and put forth effort usually succeed. | 0.29 | 2 | .865115045278 | .02578072502 ^a |
| 11R | No matter what I do, some students will not attend my science class. | 3.02 | 2 | .2203637622 | .08329442731 ^a |
| 12 | Teachers' high expectations of CLD students enable them to develop positive attitudes, perceptions, and a high self-efficacy of academic ability. | 7.001 | 2 | .03012034932* | .1267547346 ^a |
| Negative Attitudes Towards Inclusion of CLD Students in Subject Area Classes | | 8.34 | 4 | .07972946266 | .07978293937 ^a |
| 14 | Having CLD students in my science classes increases my workload. | 0.322 | 2 | .8508951852 | .02721527538 ^a |
| 15 | Having CLD students in my science classes requires more of my time than other students require. | 3.71 | 2 | .1568402251 | .09218369341 ^a |
| 16 | Having CLD students in my science classes slows the entire class's progress. | 1.382 | 2 | .5009658837 | .05611642943 ^a |
| Positive Attitude towards Inclusion of CLD Students in Subject Area Classes | | 15.07 | 4 | .004556615637* | .1315403487 ^a |
| 13 | Having CLD students in my science classes benefits all students. | 3.90 | 2 | .1424238101 | .09455225457 ^a |
| 17 | Having CLD students in my science classes creates a positive educational environment. | 3.92 | 2 | .1405565032 | .09498083807 |
| Teachers' Beliefs about CLD Students Enrolled in their Subject Area Classes | | 43.50 | 4 | 8.14E-09* | .1412637904 ^a |
| 18R | Regardless of cultural differences, all students should be taught in the same way. | 1.31 | 2 | .518780708 | .05486739699 ^a |
| 22R | Science teachers need more time to deal with the needs of CLD students. | 5.83 | 2 | .0541035821 | .115672245 ^a |
| 23R | CLD students should not be allowed to use their home language in science classes. | 7.10 | 2 | .02874940008* | .1275948717 ^a |
| 24R | CLD students should only enroll in general education classes once they attain a minimum level of standard English proficiency. | 3.94 | 2 | .1396950627 | .09502035889 ^a |
| 25R | CLD students in my science class participate less than other students. | 4.99 | 2 | .08223676704 | .107048664 ^a |
| Teachers' Attitudes towards CLD Students' Needs | | 35.09 | 3 | 1.17E-07* | .1266939394 ^a |
| 19 | Knowing the background and the experiences of CLD students is a significant element to increasing their learning achievement. | 15.04 | 2 | .000543214842* | .1863469864 ^a |
| 20 | It is part of my responsibility as a teacher to use different teaching instruments (formal, symbolic, and media), to help convey important information, values, and actions about cultural and linguistic diversity. | 26.19 | 2 | .000002050432* | .2442734587 ^b |
| 21 | Meeting the individual needs of all my students is an important part of my science lesson plans. | 6.18 | 2 | .04544654025* | .1189430682 ^a |
| 26 | Science materials help students understand how people from various cultures and groups have contributed to the development of scientific knowledge. | 6.09 | 2 | .04739918416* | .1186753341 ^a |
| 27 | Science materials should help students to understand how assumptions, perspectives, and problems within these fields are often culturally based and influenced. | 5.94 | 2 | .05139679493 | .1156294848 ^a |

* p -value < .05, ^a $CV \leq .2$, weak association, ^b (.2 < $CV \leq .6$, moderate association), ^c $CV > .6$, strong association

Table 13 shows that all constructs present a significant difference in responses before and after the training. In other words, the responses before the training are not independent of those after the training. This could suggest that the training affected the responses. However, all constructs present Cramer's V close to 0, suggesting weak associations. Only item 20 (*It is part of my responsibility as a teacher to use different teaching instruments (formal, symbolic, and media) to help convey important information, values, and actions about cultural and linguistic diversity.*) presented a moderate association of responses.

Table 14

Abstracted TakeAways of Participants

What is your take-home message?

| Sample responses | Codes | Themes |
|---|----------------------------------|----------------------------------|
| <i>Inclusivity will be implemented</i> | Inclusive science education | Inclusivity in Science Education |
| <i>I have learned that CLD students must be catered by their science teachers for them to be able to cope and learn a lot of things in the class.</i> | Respective and acknowledging CLD | |
| <i>Never get tired of learning</i> | Lifelong learning | |



Technology will never replace educators. Thus, technology in the hands of a good educator will promote transformative learning that will alleviate the situation of our country, in general.

To be an effective teacher, I realized the importance of carefully planning the lesson, the benefits of using flipped classroom, and technological integration in teaching.

Teachers are not just mere teachers, they are creative and explorers.

We will make Science a more interesting and interactive one.

Be passionate

Let us make our classroom more inclusive. Let us make science inclusive and accessible

Students came to school to learn and not to have fun

Role of Technology

Role of Lesson Planning

teacher creativity, open mind, and sense of curiosity through training

Attitude towards teaching science

Goal of science education

Nature of learning science

Teacher competencies, skills, and attitudes

Goal and nature of science education

Based on the coded and abstracted participant responses in the open survey (Table 14), they benefitted from the training in terms of acknowledging inclusive science education, CLD students and their states, and the importance of lifelong learning which are themed inclusivity in science education. The participants also realized that teachers' skills, knowledge, and attitudes are vital in implementing an inclusive science classroom. They could now connect all these realizations to the goals and nature of science education. In addition, Table 15 presents the themes generated from the coding and abstraction of the participants' responses regarding how they will implement what they have learned in the training.

Table 15

Teachers' Implementation of their Learning in the Training

| Is there anything you'd like to try implement to your classroom? How? | | |
|--|---------------------------------------|---|
| Sample responses | Codes | Themes |
| Inclusivity. By building healthy and respectful environment I would like to implement the flipped classroom to help students more excited in learning Science | Inclusivity | Inclusive Science Education |
| I want to implement a classroom setting which can help the students to grow, to develop and improve their skills. I will also intend to employ what I learned from these sessions. | Sensitization | |
| I would allow my students to explain their answer using their mother tongue (to help them elaborate their ideas, as well as their classmates could also learn their language.) | Culture-based approach | |
| I would like to implement using different languages inside the classroom. I can do this by trying to identify my CLD learners and try to communicate with them using their mother tongue. | Language-based approach | |
| Giving challenge to students may help in making them use their critical thinking and collaborative skills. | Skill-based teaching | Addressing the nature of science learning |
| I would aim to introduce interactive learning methods and diverse perspectives into the curriculum, possibly by incorporating multimedia resources, promoting group discussions, and integrating case studies that highlight a range of cultural backgrounds. This approach is intended to boost student engagement and comprehension. | Experiential learning with technology | |
| Differentiation technique, by giving activities differently suiting the capabilities of learners | Differentiation | Appropriate teaching approaches for Inclusive and Engaging Science Learning |
| Teaching as telling and learning as listening is not anymore the trend today. Hence, I should implement Educational Technology in my classroom that also fits the context of the community. Yes, about the Technology integration. In every part of the lesson, technology can be utilized for better and productive learning. | Technology integration | |
| A good communication in a class is the most important to me. | Communication | |
| If there is something I would like to implement inside my classroom is the use of online interactive learning applications. I will use it during my discussions to help them analyze the topic more and at the same time they will be engaged and be able to participate actively inside the classroom. | Teaching Strategies | |

The pre-service science teachers saw that it was important to implement several aspects of what they have learned in the training in their science classes. The coding process shows that these participants would want to implement inclusive science education through sensitization and using culture- and language-based approaches. They also claim that in addressing the nature of science learning, the following are very important factors: skill-based teaching, experiential learning with technological applications, and utilization. Finally, they deem it important to use appropriate teaching approaches for inclusive and engaging science

learning. These may be implemented through differentiation, technology integration, communication, and appropriate teaching strategies.

Dissemination

Dissemination of ESTA products through the Development of ESTA-OER for Lesson Exemplars and Hook videos developed by Science Teachers - OER

Through the training workshop and the implementation of courses, selected participants developed several Lesson exemplars (LEs). The ESTA-Philippines-PNU team subjected all developed LEs to peer review, presentation, and critiquing by mentors and a panel of evaluators at the culmination of the training sessions. With these Lesson Exemplars, the participants could create hook videos in their mother tongue and subtitle them in English.

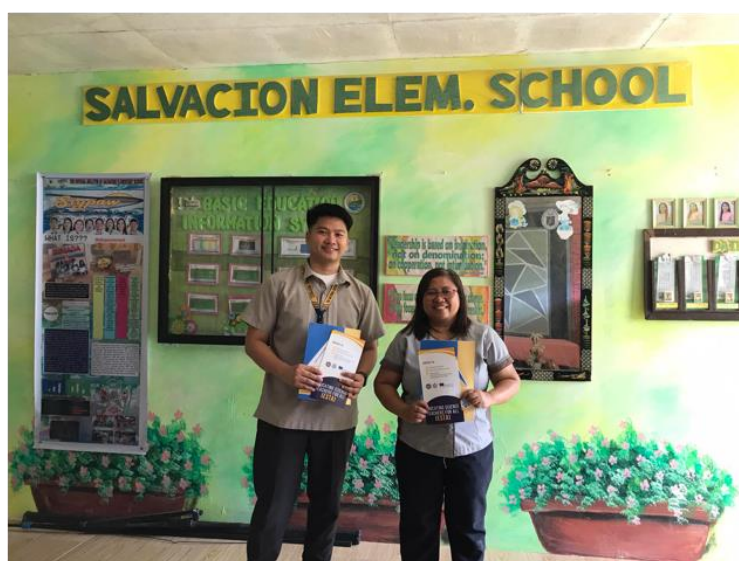
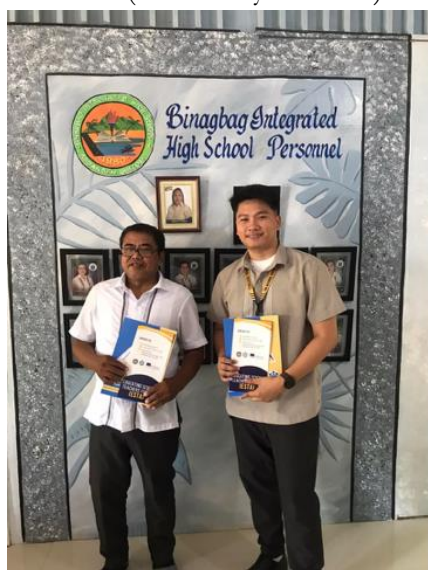
With a wealth of products generated from the training and implementation of the enhanced courses, the team developed the ESTA-Open Educational Resource as a repository for all the products. The ESTA-Philippines-PNU team utilized the open-source software of PKP (Public Knowledge Project). PKP, known as OMP (Open Monograph Press), offers open-source software for publishing books and monographs. Currently, the ESTA OER hosts 45 products generated from the ESTA program at PNU. Continuous uploading of resources will provide better resources to Philippine science teachers for inclusive science education.

Other Dissemination Strategies

Other means of disseminating the ESTA program/project:

Distributing brochures and copies of frameworks to in-service and preservice teachers. The figures below provide sample documentation. Additionally, Table 16 provides a complete list of dissemination activities done the members of the team.

In-service (Elementary Teachers)





ESTA

Pre-service Science Education students of Occidental Mindoro State College



Pre-service and In-service Science Education students of Philippine Normal University





ESTA

Pre-service and In-service Science Education students of Philippine Normal University





ESTA

Table 16

Dissemination of ESTA through flyers and framework distribution

| Type of Activity | Date of Dissemination | Target groups | Number of persons reached | Comments (effects, observations, problems, etc.) |
|---|-----------------------|----------------------------|--|---|
| Jose Rizal Memorial State University Academic Conversations on Flexible Learning in Rural Schools: Implications to research paradigms and practices | May 2, 2023 | In-Service Teachers | Faculty and students of JRMSU campuses | Information about ESTA project partners and ESTA project ideas. |
| Mariano Marcos State University workshop on MILEScie-A: Mastering Instruction in Laboratory through Empowering Science Teachers for Achievement | April 14-16, 2023 | In-Service Teachers | Faculty and Students and In-service teachers of MMSU and DepEd | Promotion of study of science and ESTA project ideas. |
| Pasig Elementary School | May 4, 2023 | In-service teachers | Science Department Faculty | Promotion of study of science and ESTA project ideas. |
| Paso De Blas National High School | May 4, 2023 | In-service teachers | Science Department Faculty | Promotion of study of science and ESTA project ideas. |
| Graduate School Class day at the Faculty of Graduate School | May 9, 2023 | Masteral Graduate Students | Four | Information about ESTA project partners and ESTA project ideas. |
| Far Easter University High School Sampaloc Manila | May 11, 2023 | In-service teachers | Science Department Faculty | Information about ESTA project partners and ESTA project ideas. |
| Concourse Convention Center, Legazpi, Albay | May 11, 2023 | In-service teachers | Junior and Senior high School faculty members | Promotion of study of science and ESTA project ideas. |
| Bayugo Elementary School Meycauayan City Bulacan | May 11, 2023 | In-service teachers | Science Department Faculty | Information about ESTA project partners and ESTA project ideas. |
| Binagbag Integrated High School Agdangan Quezon | May 31, 2023 | In-service teachers | Science Department Faculty | Information about ESTA project partners and ESTA project ideas. |



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|---|---------------------|------------------------|--|--|
| Binagbag Elementary School Agdangan Quezon | May 31, 2023 | In-service teachers | Science Department Faculty | Information about ESTA project partners and ESTA project ideas. |
| Elias A. Salvador National High School Agdangan Quezon | May 31, 2023 | In-service teachers | Science Department Faculty | Information about ESTA project partners and ESTA project ideas. |
| Salvacion Elementary School Agdangan Quezon | May 31, 2023 | In-service teachers | Science Department Faculty | Information about ESTA project partners and ESTA project ideas. |
| Atimonan National Comprehensive High School Atimonan Quezon | October 31, 2023 | In-service teachers | Science Department Faculty | Information about ESTA project partners and ESTA project ideas. |
| Atimonan Elementary Schools Districts 1 and 2 | October 31, 2023 | In-service teachers | Science Department Faculty (10 elementary and integrated schools) | Information about ESTA project partners and ESTA project ideas. |
| Pitogo High School Taguig City | December 9, 2023 | In-service teachers | Science Department Faculty | Information about ESTA project partners and ESTA project ideas. |
| San Roque High School Paombong Bulacan | December 9, 2023 | In-service teachers | Science Department Faculty | Information about ESTA project partners and ESTA project ideas. |
| Ramona S. Trillana High School Bulakan, Bulacan | December 9, 2023 | In-service teachers | Science Department Faculty | Information about ESTA project partners and ESTA project ideas. |
| Taytay National High School Taytay Rizal | December 9, 2023 | In-service teachers | Science Department Faculty | Information about ESTA project partners and ESTA project ideas. |
| Pampanga High School, Pampanga | December 9, 2023 | In-service teachers | Science Department Faculty | Information about ESTA project partners and ESTA project ideas. |



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|--|---------------------|---------------------|--|---|
| Mataas na Paaralang San Juan Laya / Guiset Sur San Manuel Pangasinan | December 13, 2023 | In-service teachers | Science Department Faculty | Information about ESTA project partners and ESTA project ideas. |
| Legaspi City National High School, Rawis Legazpi City Albay | December 13, 2023 | In-service teachers | Science Department Faculty | Information about ESTA project partners and ESTA project ideas. |
| ONdok Gawan Elementary School San Jose General Santos City | December 13, 2023 | In-service teachers | Science Department Faculty | Information about ESTA project partners and ESTA project ideas. |
| Pasil Night High School, Pasil Cebu City | December 13, 2023 | In-service teachers | Science Department Faculty | Information about ESTA project partners and ESTA project ideas. |
| Kabasalan National High School Kabasalan Zamboanga Sibugay | December 13, 2023 | In-service teachers | Science Department Faculty | Information about ESTA project partners and ESTA project ideas. |
| Buruanga Vocational School Buruanga Aklan | December 13, 2023 | In-service teachers | Science Department Faculty | Information about ESTA project partners and ESTA project ideas. |
| Mat-i Central Elementary School, Mat-i Surigao City | December 13, 2023 | In-service teachers | Science Department Faculty | Information about ESTA project partners and ESTA project ideas. |
| Mabuslo Elementary School, Mabuslo Bambang Nueva Vizcaya | December 13, 2023 | In-service teachers | Science Department Faculty | Information about ESTA project partners and ESTA project ideas. |
| Bulacan State University Bualacan | December 9, 2023 | In-service teachers | Science Department Faculty | Information about ESTA project partners and ESTA project ideas. |
| Department of Education - Regional Office 8 and Tingog Partylist - Training of Teachers on Pedagogy and AI | October 13-14, 2023 | In-service teachers | Basic Education Teachers from Division of Leyte, Tacloban, Samar | Mentioned the ESTA project during the session on teacher education in the Philippines |



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|---|----------------------|--|---|--|
| Philippine Normal University - Publications Office - Training of Pre-Service Teachers on Creative Works and Lesson Exemplar | October 18, 2023 | Pre-Service Teachers | Current Pre-Service Teachers from Philippine Normal University | Presented the ESTA products specifically the Lesson Exemplar for use by pre-service teachers |
| University of Eastern Philippines Gender Mainstreaming and Development of GAD Agenda | December 19-21, 2023 | Top Management of UEP and Gender Focal Point Persons | Different Units of University of Eastern Philippines | Presented the ESTA Project as an example of Gender Mainstreaming |
| Philippine Merchant Marine Academy Gender Mainstreaming and Development of GAD Agenda | December 7-9, 2023 | Top Management and Gender Focal Point Persons | Different Units of the Academy | Mentioned ESTA Project as an important showcase of GEDSI Perspective (Gender Equality, Disability, and Social Inclusion) |
| Commission on Higher Education | October 9-11, 2023 | Gender Focal Point Persons representing the different regions of the country | Gender Focal Point System of the Commission on Higher Education | Mentioned ESTA Project as an important showcase of GEDSI Perspective (Gender Equality, Disability, and Social Inclusion) |
| E.P Borja High School-Brgy Basiad Sta Elena Camarines Norte | December 29, 2023 | In-service teachers | Science Department Faculty | Information about ESTA project partners and ESTA project ideas. |
| Kinagunan Elementary School, Padre Burgos, Quezon | December 27, 2023 | In-service teachers | Science Department Faculty | Information about ESTA project partners and ideas. |

Table 17 provides a complete list of dissemination activities done the the members of the team in terms of participation in international and national Conferences

Table 17

Dissemination of ESTA through Participation in International Conferences

| Title of Conference | Nature of Participation | Date and Place | ESTA-PNU Member |
|---|-------------------------|-----------------|-------------------|
| 2nd International Graduate Teacher Education Summit (IGTES 2023) Theme: Sustaining Excellence in Teacher Education through Innovative and Inclusive Pedagogies Topic: Investing on Inclusivity in Science Education: The ESTA Program | Resource Speaker | August 12, 2023 | Brando C. Palomar |
| International Conference on Assessment in the New Normal Topic: Rethinking Assessment Towards Nurturing Future Ready Graduates | Plenary Speaker | May 19, 2022 | Marie Paz Morales |



ESTA

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|--|-----------------|------------------|-------------------|
| 39th SPP Physics Conference and Annual Meeting Topic: STEAM Education in the Philippines | Plenary Speaker | October 21, 2022 | Marie Paz Morales |
| Association of Southeast Asian Teacher Education Network (AsTEN) Conference Title: I-CoCONNECT (International Collaboration in the New Normal for the Enhancement of the Competency of Teachers) Topic: Sharing Models of Collaborative Research | Keynote Speaker | October 30, 2020 | Marie Paz Morales |

Table 17

Dissemination of ESTA through Participation in National Conferences

| Title of Conference | Nature of Participation | Date and Place | ESTA-PNU Member |
|--|-------------------------|--------------------|-------------------|
| 16th EARIST Research Colloquium Theme: Showcasing Innovation in Education | Plenary Speaker | August 23, 2023 | Marie Paz Morales |
| 13th PAFTE Midyear Convention themed Evidence-Based Practices and Innovations in Education through Research and Integration for Sustainability Theme: Evidence-based Practices and Innovations in Education through Research and Integration for Sustainability | Plenary Speaker | June 15, 2023 | Marie Paz Morales |
| Research Colloquium Series 28 [Theme: Research Practices and Innovations in the D-VUCAD World] | Keynote Speaker | June 7, 2023 | Marie Paz Morales |
| University Research Forum Title of Presentation: Science Capital in Focus | Presenter | May 31, 2023 | Marie Paz Morales |
| 3rd PEARL (PAPSCU Excellent Academic Research Link) Multidisciplinary Research Conference organized by the Philippine Association of Private Schools, Colleges and Universities (PAPSCU) Theme: Harnessing Partnership and Collaboration Towards Research in the Next Normal | Keynote Speaker | March 4, 2023 | Marie Paz Morales |
| National Training Workshop in Inclusive Science Education for Linguistic and Cultural Diversity for Pre-Service Teachers Topic: Science Education Landscape in the Philippines | Plenary Speaker | September 27, 2023 | Marie Paz Morales |
| 2nd National Research Conference Theme: Resilience, Collaboration, Innovation thru Research | Plenary Speaker | December 1, 2022 | Marie Paz Morales |
| NINGAS: National Teachers College Research Congress 2022 Theme: Evidence-based Research on Resilient Education 2.0 | Keynote Speaker | October 12, 2022 | Marie Paz Morales |
| National Training Workshop in Inclusive Science Education for Linguistic and Cultural Diversity Topic: Science Education Landscape in the Philippines | Plenary Speaker | July 19, 2022 | Marie Paz Morales |
| National Training Workshop in Inclusive Science Education for Linguistic and Cultural Diversity Topic: Science Education Landscape in the Philippines | Plenary Speaker | January 27, 2022 | Marie Paz Morales |



ESTA

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|---|-----------------|-------------------|---------------------|
| National Conference <i>Topic:</i> Harnessing the 21st Century Skills of Teachers and Learners in the HEI during the Pandemic | Plenary Speaker | August 7, 2021 | Marie Paz Morales |
| Teaching Science Research | Speaker | July 11, 2021 | Marie Paz Morales |
| Lopez Research Congress | Keynote Speaker | November 22, 2023 | Leah Amor S. Cortez |

Other Methods, Tools, and Instruments

Below is a list of the instruments and tools that the team used in completing the deliverables of the project:

Science Education for Linguistic and Cultural Diversity in Philippine Public Higher Education (SELC-PhPHiEd) [\[Link\]](#)

The framework for Science Education for Linguistic and Cultural Diversity in Philippine Public Higher Education (SELC-PhPHiEd) is visualized to encompass three major components: the Filipino learners, the pedagogies and pedagogical frameworks, and the teachers' knowledge system in terms of enacting the science curriculum. SELC-PhPHiEd presents the general constructs of focus in undertaking curricular modifications, enhancements, and enactment. These general constructs outline how the blueprint may also inform the different teacher education processes that inform teacher's knowledge, training, and research in pedagogies and the development of products for teaching and learning, such as Lesson Exemplars, modules, and assessment within the bounds of linguistic and cultural inclusivity. SELC-PhPHiEd is PNU's vehicle to concretely advocate the transfer of technology and disseminate knowledge on linguistic and cultural inclusivity to other Teacher Education Institutions for higher-quality science education in the country.

Validation Questions

1. These are a set of questions prepared for all participants of the Focus-Group-Discussion to
2. validate the team-developed framework (Science Education for Linguistic and Cultural
3. Diversity in Philippine Public Higher Education [SELC-PhPHiEd] These questions are as
4. follows:
5. What is your aspiration/vision for science teachers to achieve science education for all?
6. What can you say about the features/ principles/ assumptions of this ESTAPHIL Framework?
7. What other features/ principles/ assumptions will you include if you design an inclusive science education program for teachers?
 - i.

Framework Integration Model [\[Link\]](#)

This document provides a flexible process for integrating the ESTA-Phil-PNU framework into the curricular program or syllabus of undergraduate (pre-service) and graduate (in-service) students of science education at the university. Documents may be accessed at this link for pre-service and in-service.

Lesson Exemplar Template and Rubric [\[Link\]](#)

The Lesson Exemplar Template is a product derived from the ESTA-Phil-PNU Framework: Science Education for Linguistic and Cultural Diversity in Philippine Higher Education (SELC-PhPHiEd) that transitions that framework into a usable product for teachers. It aims to codify the framework to help



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teachers craft meaningful lessons for Filipino learners who are culturally and linguistically diverse. The template comes with a Rubric to establish quality before, during, and after the development of Lesson Exemplars.

Video Hook Guidelines [\[Link\]](#)

This document emphasizes the guidelines for creating video hooks for science. It also includes a Rubric to guide developers in quality and content.

Training Handouts for Keynote, Plenary, and Academic Staff Tour [\[Link\]](#)

These materials were used by the resource speakers and trainers of the workshop and are available for viewing by the participants for a thorough understanding of the inputs, principles, concepts, ideas, and activities that may help the teacher-participants address CLD in their science classrooms.

Peer Review Form [\[Link\]](#)

This form is intended to assist the developers of Lesson Exemplar in improving their work. The peer review form includes items that focus on the assessment of a peer on the currently-developed Lesson Exemplar.

Evaluation Form [\[Link\]](#)

This form is an assessment of the entire Training Program from the perspective of the teacher-participants. The form includes two parts. Part 1 is a Likert scale that determines teacher participants' ratings regarding the following constructs: overall order of the training program, program content, time management, attainment of purpose, and resource speakers. Part 2 is an open survey that focuses on participants' learning, benefits from the training, and other comments.

Pre-service and In-service evaluation [\[Link\]](#)

This evaluation instrument is adapted from the main document developed by the ESTA team. This instrument comprises the pre-service Teacher Questionnaire and the in-Service Teacher Questionnaire. Each section will be implemented as **pre-and post-tests** for a seminar lasting several weeks/a whole semester. **Part I** consists of the questions for the pre-test, and **Part II** consists of the questions for the post-test.

ESTA-Open Educational Resources (ESTA-OER) [\[Link\]](#)

This Open Educational Resource is intended for all the products of the European Union-funded research project, Educating Science Teachers for All (ESTA). These resources are crafted by the core team, which includes trained University Science Teacher Educators and Basic Education Science Teachers. This press aims to share knowledge for quality science education in the Philippines.



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Possible adaptation to the local context

Hook videos

Science teachers in the Philippines benefited from introducing Hook Videos by ESTA to the ESTA-PNU team. ESTA-PNU designed the [hook video guidelines](#) to help science teachers design their hook videos adapted to their diverse learners. The key features of this adaptation were the integration of the mother tongue (with an English subtitle) and the use of local materials in the video lessons.

Lesson Exemplars

With the developed [Lesson Exemplar template](#) (by the ESTA-PNU team), science teachers in all levels of education may be able to design their lessons based on and informed by their respective students' cultural and language backgrounds. They may be able to customize their lessons using materials available in their locality. They may also design a coherent assessment to match their lessons and student capacity.

Course Enhancement Protocols

Following the [framework integration model](#) [a model developed by the ESTA-PNU team that specifies how enhancement of the courses may be done in clusters (pre-service specialization courses, pre-service PCK courses, in-service core courses, and in-service specialization courses)], all university science educators may be able to design their enhanced course syllabi for pre-service and in-service according to how they would like to engage their students in sensitization to address CLD in Philippine science classrooms.



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