Science Teacher Academy for the Regions: Empowering Teachers with Content and Pedagogy

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Abstract

Project Science Teacher Academy for the Regions (STAR) is "an organized scheme of capacity-building efforts aimed at increasing instructional capacity and content knowledge of teachers with the end goal of enhancing the teaching and learning of science and mathematics". Initiated by the Department of Science and Technology – Science Education Institute (DOST-SEI) in the Philippines, it consists of contextualized teacher-training programs and other capacity-building activities that are designed to blend the latest pedagogical approaches and strategies with scientific and mathematical content. Project STAR has three main objectives: (1) to develop the capacity of science and mathematics teachers in the basic education and tertiary level; (2) to promote new strategies, and models as wells as concepts in teaching and learning of science and mathematics; and (3) to establish a professional learning community of S&M advocates/ experts for information and resource exchange. To achieve these objectives, it has partnered with seventeen (17) Universities and Department of Education regional offices nationwide. Faculty members of the science and mathematics department of the said universities served as pool of trainers who were trained on innovative STEM teaching approaches, and eventually implement the training program to in-service teachers in their respective localities or nearby province. It is desired that the STAR program will serve as catalyst in developing professional learning that will empower teachers in content and pedagogy.

1. Introduction

The government recognizes the importance of human resource development in nation building. As the agency mandated to develop the human resource capacity in science and mathematics in the Philippines, the Science Education Institute of the Department of Science and Technology initiated the Project STAR or Project Science Teacher Academy for the Regions. Through its activities, it intends to provide the Filipino teacher with the skills and content mastery to deliver lessons effectively and efficiently. Ultimately, it hopes that by equipping teachers with the appropriate know-how, students of science and math will grow into productive and conscientious citizens of the nation and the world.

The scope of Project STAR is nationwide; it uses the cascade model to deliver training to teachers across the country. DOST-SEI works with 17 teacher education institutions (TEIs) in the different regions as well as the regional offices of the Department of Education (DepEd) to deliver training to teachers. Approximately, there are one hundred forty trainers, seventy each for science and mathematics, form a national trainer pool that assists DOST-SEI in its various training programs.

2. Literature

DOST-SEI needs to address the lack of a scientific human resource ecosystem in the Philippines. De La Pena and Biyo [1] pointed out that every activity made by DOST-SEI was intended to enhance the educational system particularly in the field of STEM. With this, the goal was to develop a new generation of Filipino teachers, scientists and researchers through teacher training programs, science appreciation campaigns, competitions, among others.

One way of developing the STEM community is through teacher professional development. Models that support the teacher are numerous however, simultaneously training many teachers remains difficult. This challenge can be addressed in a short period of time through the cascade model [5]. In the study by Ngeze et al. [5], the teachers need to have rich domain knowledge, prior workshop experience, time management and content ownership skills for the cascade model to be effective.

In Africa, the study of Massaquoi [2] indicates that the Network of Centers of Excellence concept is a great way to provide high-caliber research that advances regional and national development, but it could not be helpful in producing a lot of researchers to increase the region's human resource capabilities. The best chance for quick, cost-effective, large-scale human resource capacity growth is found in institutional networks, including strong and weak. It is believed that Africa requires both models: one for increasing human resource capacity in higher education institutions and the other for producing high-quality and pertinent research to solve the region's problems [2].

Darling-Hammond et al. found seven widely shared features of effective professional development – content focused, incorporates active learning,

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supports collaboration, uses models of effective practice, provides coaching and expert support, offers feedback and reflection, is of sustained duration [3].

This paper presents the strategy and characteristics of the professional development program that is being implemented in the Philippines for STEM teachers, both in the basic education and tertiary level.

3. Strategy

Initially, a group of science education experts were gathered to finalize the structure, services, and the list of training programs to offer. Thereafter, a memorandum of agreement (MOA) was signed by the Presidents of the 17 universities involved in the project. In the said agreement, the seventeen (17) groups of trainers composed of faculty members of the science and mathematics education department of partner universities, as well as the science and mathematics supervisors of Department of Education will train basic education teachers on innovative STEM teaching approaches. After the training, the training is cascaded to in-service teachers of their respective localities or nearby province but adjusted to become contextualized and culturally sensitive. It is a fact that the Philippines is composed of regions, with each region possessing its own dialect, culture, and traditions. Therefore, local trainers will help in communicating ideas and information effectively. This way, there is better and greater connection to real-life situations. Further, locally available materials are utilized for activities and experiments. Another innovative feature of the program is the two-prong effect of training faculty members of the TEIs. Aside from cascading the training to in-service teachers to their own region, they are also able to integrate the innovative teaching approach to pre-service teachers whom they are teaching in the department, who will eventually become in-service teachers also.

4. Partner agencies

To serve as support mechanism, the program engaged the participation of DOST-SEI's institutional partners situated in seventeen (17) regions of the country. These are regional offices of the Department of Education, and the partner universities are higher education institutions (HEI) conferred as Centers of Excellence or Centers of Development COE or COD by the Commission on Higher Education, therefore having a good track record of producing quality teachers in the field of science and mathematics education.

Figure 1 shows the partner universities nationwide which are the Saint Louis University (Cordillera Administrative Region), Mariano Marcos State University (Region 1), Saint Mary's University (Region 2), Central Luzon State University (Region 3), Batangas State University (Region 4-A), Palawan State University (Region 4-B), Philippine Normal University (National Capital Region), Bicol University (Region 5), West Visayas State University (Region 6), Cebu Normal University (Region 7), Leyte Normal University (Region 8), Ateneo De Zamboanga University (Region 9), Mindanao State University-Iligan Insitute of Technology (Region 10), University of Southeastern Philippines (Region 11), University of Southern Mindanao (Region 12), Caraga State University (Caraga Region), and Mindanao State University Marawi City (Bangsamoro Autonomous Region in Muslim Mindanao).

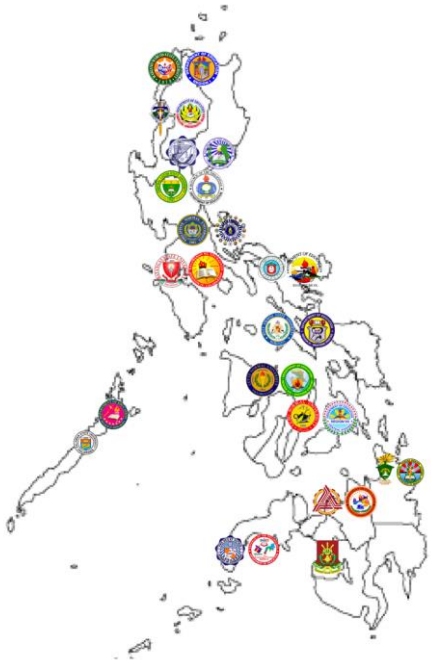

Figure 1. Project STAR partner universities

5. Roles and Responsibilities of Agencies Involved

1. DOST-SEI determines the nature of the training, designs, and organizes the training of trainers, organizes, and supervises the regional trainings.
2. DOST-SEI staff shall serve as facilitators and are responsible for the preparation before the training, ensuring that the training proceeds smoothly, and conducting the post-training activities.
3. Participants to the national training of trainers are nominated by their respective universities and the Education Program Supervisors in Science and Mathematics of the DepEd Regional Offices.
4. Participants to the regional training are nominated by the DepEd Regional Offices with the assistance of the regional supervisors. These participants are teachers and/or supervisors in the school division offices covered by the corresponding DepEd Regional Office.

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5. Participants to both national and regional trainings are expected to prepare an action plan on how they will share their learnings with other teachers and/or apply their training in their classrooms.

6. Trainings

There are currently seven (7) Project STAR trainings, all of which are characterized by a blend of pedagogy and content. They are designed to fit into the basic education curriculum and complement the approaches and strategies currently used in Philippine classrooms. These trainings share some similar characteristics, including:

1. *The equal emphasis on content and pedagogy* – even as trainings are designed to provide new approaches, techniques or strategies for teaching and learning, they also contain a lot of content and sessions provide opportunities to discuss problematic concepts.
2. *The inclusion of workshops and experiential learning opportunities* – the sessions in the trainings allow participants to experience for themselves how the pedagogical practices can be applied in teaching – learning situations.
3. *The opportunity to craft products using the new tools provided by the training* – all trainings end with a culminating workshop in which participants prepare outputs, usually in the form of lesson plans or exemplars, using and adapting the learnings from the training.

The trainings, whether science or mathematics consists of three parts, namely input sessions, sample teaching and workshops. The inputs sessions are mostly selected topics that would set the tone of the over all training; sample teaching involves choosing a specific strand topic on a particular grade level foe actual teaching demonstration; and workshops are on the development, implementation, critiquing, and revision of research lessons including assessment items or tasks, and preparation of action plans on the regional in-service teacher training.

6.1. Teaching Mathematics through Problem Solving

This training familiarizes teachers with the process of teaching mathematical concepts by allowing students to explore and find solutions to problem situations. Participants to this training are given the opportunity to experience lesson simulations as well as develop lessons using the technique under the supervision of an expert. Workshops on how to conduct lesson study sessions and discussions on the importance of lesson study to teacher development are also included.

Participants to this training are expected to be able to differentiate between teaching through problem solving, teaching for problem solving, and teaching problem solving. They are also expected to gain skills in the development and critiquing of lessons employing teaching through problem-solving.

6.2. Inquiry-based Approach for Teaching Science

This training emphasizes the use of inquiry-based teaching using the 7E model (elicit, engage, explore, explain, elaborate, evaluate, and extend). Participants to this training attend lesson simulations in Physics, Chemistry, Biology, and Earth Science and develop their own lesson samples using the 7E template.

At the end of the training, participants are expected to develop sample lessons that clearly articulate the use of the 7E model. They are also expected to develop the skill of critiquing and adapting lessons to the 7E format.

6.3. Interdisciplinary Contextualization for Science and Mathematics Education

This training demonstrates how local contexts (places, culture, and practice) as well as materials and topics of other subjects, such as English or history, can be used to teach science and mathematics concepts. The training also explains how this contextualization can increase the relevance of classroom lessons to daily life. The training includes lectures and lesson simulations that feature interdisciplinary contextualization.

Participants of this training are expected to develop and demonstrate a lesson that features interdisciplinary contextualization and the use of teaching through problem solving (for Mathematics) or inquiry approach using the 7E model (for Science). They are also expected to participate in the critiquing and revision of lessons at the end of each demonstration.

6.4. Language Strategies for Teaching Science and Mathematics

Participants of this training are oriented on the importance of language in communicating understanding of science and mathematics concepts as well as the usefulness of language learning methods in the teaching of science and mathematics. The training consists of exercises in vocabulary building as well as sentence and frame construction. Participants are also given the opportunity to develop lessons incorporating language techniques.

Participants of this training are expected to demonstrate skill in incorporating language exercises into science and mathematics lessons. Participants

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must also gain skills in assessing whether the incorporation of the exercises are appropriate and to recommend changes when necessary.

6.5. Design Thinking for K-3 Science and Mathematics Teaching

This training introduces a problem-solving strategy of broad application involving five steps – empathize, define, ideate, prototype and test. The training includes simulations and lectures on how to incorporate design thinking into classroom activities. The training workshops in most allow the participants to experience going through the various steps of the design process.

At the end of the training, participants should be able to use the design thinking process in a variety of teaching-learning situations. They should also be able to recommend revisions to any of the design thinking steps to realize practical and effective solutions.

6.6. Designing Assessment Activities for Blended Learning in Science and Mathematics

This training discussed the characteristics of blended learning and the basic principles of assessment, including the tools and their features that can be used for blended learning.

Participants to this training are expected to develop a lesson plan in a blended learning environment with assessment activities, both summative and formative. They are also expected to assess whether the assessment activities are suitable and appropriate in the lesson.

6.7. Instrumentation and Improvisation in Science and Mathematics Teaching and Learning

This training familiarizes teachers with the benefits of the use of instruments and improvised materials in the different parts of the teaching-learning process to both teachers and learners. It defines the terms improvisation and instrumentation in the context of science and mathematics and describes the attitudinal traits that must be acquired to gain skills and confidence in improvisation and its use in developing innovative, immersive, and effective materials and lessons in science and mathematics. There are workshops on how to construct improvised materials and a simulation where participants take on the role of students to design and construct improvised products that will respond to a particular problem or situation.

Participants to this training are expected to be able to demonstrate skills in instrumentation and improvisation, specifically in the design of learning materials that are suitable in the lesson. Participants must also assess the quality of instruments or improvised materials in terms of suitability and effectiveness in relation to different stages in the learning process.

7. Monitoring and Evaluation

Monitoring and evaluation are conducted to determine the effect of Project STAR trainings on the teaching practice of participants. This activity seeks information from the participants on the following aspects of Project STAR trainings:

a. The perception of participants regarding the relevance and usefulness of STAR trainings to their teaching practice and other aspects of their work;
b. The extent of adaptation of STAR training content and skills into their teaching practice; and
c. The quality of adaptation of STAR training content and skills by selected teaching participants.

7.1. Monitoring and Evaluation Activities

The conduct of monitoring and evaluation is facilitated by DOST-SEI with the assistance of the partner universities and DepEd. There are four activities conducted for monitoring and evaluation, as described in Table 1 below. The table is also arranged in the order that the activities are conducted.

Table 1. Details of monitoring and evaluation activities

Activity	Purpose
Project STAR Participants' Survey	- compile the professional profiles of STAR trainees - determine the teaching practices of the STAR trainees in terms of inquiry-based learning (IBL), teaching through problem solving (TTPS), interdisciplinary contextualization (Icon), lesson study (LS) and other teaching strategies - determine the extent to which the teachers were capacitated through the STAR trainings
Evaluation of Training Outputs (Focused Group Discussion)	obtain detailed information on selected participants' understanding of the expected outcomes and use of the training content

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Evaluation of Training Outputs (Interview)	- gather information about the teacher's pedagogy, teacher activities, perceptions and extent of the pedagogy's influence on their plans
Evaluation of Training Outputs (Classroom Observation)	- determine the quality of adoption of training content into teaching practice - document best practices in the implementation of skills or competencies gained from training - identify issues that need to be addressed in future trainings

7.2. Instruments

The following are the instruments developed for the monitoring and evaluation activities:

1. *Survey Questionnaire.* This is an online survey which will gather the teachers' demographic profile in terms of sex, age, position, trainings attended, situation where STAR trainings are applied and participation to lesson study group. In addition, Likert type items on their teaching practices and professional attributed of a science/mathematics teacher was used to determine the respondents' extent of agreement to statements on the usefulness of the training. The result of the Likert scale was used to determine the participants of the focus group discussion.
2. *Focus Group Discussion Protocol.* This instrument provides guidelines in the preparation and conduct of the FGD such as the selection of the FGD participants for Science and Mathematics based on the result of the survey, the roles of the facilitator and co-facilitator. The instrument also includes fifteen question that aimed to determine the teachers' insights on the trainings they attended as well as its significant contribution to classroom instruction. Consent forms were given to the participants to ensure that the teachers agree with their participation.
3. *Classroom Observation Rubric.* This instrument covers statements on categories that are important facets of instructional practice- lesson planning, content and pedagogical knowledge, communication skills and classroom management. Open-ended items that focus on students and teacher-student interactions are also included.
4. *Interview Protocol for the Immediate Supervisor.* This includes the protocol before, during, and after the interview, and the set of interview questions used to the immediate supervisor. This instrument aimed to determine to what extend the STAR training enhanced the teachers' capabilities on the point of view of the supervisor who may be the principal, department chair or anyone who has direct supervision of the teacher. Before the interview, there is a consent form to be given to ensure that the supervisor agrees on the interview.
5. *Interview Protocol for the Students.* Questions were not person focused but on the teaching process. Assent forms were given to the students before the interview to ensure that the students agree to the activity.

7.3. Monitoring and Evaluation Instrument Administration

Respondents are selected based on the fundamental criteria that they have attended at least one of the Project STAR trainings. Table 2 below shows the instruments and their method of administration.

Table 2. Monitoring and evaluation instrument administration

Name of Instrument	Method of Administration
Survey Questionnaire and Scale	All participants of Project STAR trainings are contacted and requested to fill up an online form. The target retrieval percentage is 75% of the total number of registered participants per region.
Focused Group Discussion Interview Guide	Eight (8) participants to the FGD are chosen from the result of the survey using the "scores" as basis. These participants are as follows: (a) 2 participants from upper group (mean +1SD); (b) 2 participants from the lower group (mean -1SD); (c) 2 participants from the middle group; and (d) 2 participants chosen by the evaluation team for certain reasons. These participants are invited to the discussion and an interview schedule is used by a facilitator for the focused group discussion.
Lesson Observation Instrument	Three (3) participants from the focused group discussion are chosen for the school visit and classroom observation. The trainers are given the discretion of choice, but preference is given to those whose responses during the FGD

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	are remarkable or have made claims that can be verified with a visit. During the school visit, trainers will observe classes of the participant and conduct interviews with him/her, the students, and the principal.

8. Conclusion

It is not enough for DOST-SEI to sustain the program. Together with concerned agencies, we must work hand in hand. We need a network of concerned agencies to be able to continue to offer innovative trainings responding to the changing needs of the education landscape. The national strategies in support of learning in science and mathematics suggest a work in progress involving consultations with national leaders, influential scientists and experts in science and mathematics education, groups, and institutions with an interest in learning Science and Mathematics.

9. References

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