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Science Investigatory Project Instruction: The Secondary Schools' Journey

Joje Mar P. Sanchez*
sanchezj@cnu.edu.ph
College of Teacher Education, Cebu Normal University
Osmeña Boulevard, Cebu City, Philippines

Rufina C. Rosaroso
College of Arts and Sciences, Cebu Normal University
Osmeña Boulevard, Cebu City

Abstract Science investigatory projects (SIPs) are authentic tasks that science teachers implement in science curriculum. With this, the study investigated the journey of the secondary schools in SIP instruction through the lens of the teachers. Narrative inquiry from 12 purposively selected and interviewed science teachers/winning coaches from six schools in an SIP consistent winning Division in Central Visayas, Philippines revealed that the SIP instruction journey is affected by the teachers' prior background and implementation. They are seen to be instrumental in the SIP process, as they instill basic research skills to high school investigators, and develop the science character which is needed for them to engage in innovations in science and technology (S&T). As the teachers implement SIP instruction, they commit themselves to the development of S&T, thus placing a crucial role in the scientific community where they also develop the science research culture in the basic education level. Science teachers then should guide the students in the planning, conduct and assessment phases of SIP instruction.

Keywords: investigatory projects, science teaching, secondary schools

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Introduction

Science is vital in the development of the world (DiChristina, 2014). In fact, research endeavors in the sciences led to the formulation of significant concepts, principles and theories, which modern technology demands. This significance is seen in the utilization of knowledge and application of scientific method in the improvement of priority and advanced fields. As such, science research lays the foundation of efficiency, productivity and innovation in the society (National Economic and Development Authority, 2017). In other words, Science research is cascaded to the different sectors of the society, including the basic education sector.

Science Research in the Philippines

In the country, science research is promoted and fostered in accordance with Republic Act 2067 [Science Act of 1958], as an effective instrument to intensify science and technology (S&T), and research and development (R&D) for national progress. The law is promoted by the current administration through advancing S&T and innovation in the country as stated in the Philippine Development Plan 2017-2022. The six-year development plan supports science R&D productivity and innovation to accelerate technology adoption, and stimulate innovation in all economic sectors as foundation of a globally-competitive knowledge economy (NEDA, 2017). Promotion of R&D in S&T, and innovation by the country also adheres to Industrial Revolution 4.0 IR40, which showcase the fusion of technologies across physical, digital, and biological systems (Technical Education and Skills Development Authority, 2016) that could support sustainability in agriculture, education, healthcare and environment (Albert, Orbeta, Paqueo & Serafica, 2018). Hence, these frontier technologies of the fourth revolution may stir the country's S&T, thus is streamed down to the different sectors of the society: the government, private enterprise and academe.

Recent trends in R&D show that the government initiatives in science research focus on citizen welfare and human development while those of the private enterprise are geared towards technological and medical advances (Albert, Yasay & Gaspar, 2015; Olvido & Sanchez, 2017). In fact, Department of Science and Technology (the country's agency responsible for S&T initiatives) articulated its harmonized national R&D agenda in order to provide maximum economic and social benefit to the Filipinos (DOST, 2018). Similarly, the Commission on Higher Education (CHED) mandates to advance S&T in the academe to enhance learning and research, wherein faculty members are encouraged to conduct science researches, publish these in reputable journals, and present these in accredited conferences (CHED, 2009; Salazar-Clemeña & Almonte-Acosta, 2007). This trifocal system of the government, the private business enterprise, and the academe provides the arena for progress and development of S&T in the country.

Cascading the Science Research Goals to Basic Education

The science research goals of the country are also pitched down to the basic education level. The national research goals are embedded in the basic education research agenda formulated by the Department of Education (DO No. 39, s. 2016), particularly in teaching and learning (T&L) agenda. Accordingly, in T&L, science studies may be integrated in instructional materials development, community contextualization, and performance-based assessments. In basic education, the latter two make science research possible to be conducted by elementary and high school students – through science investigatory projects (SIPs). These projects are instruments for students to make real-world connections and solve problems in their community (Autiere, Amirshokoohi & Kazempour, 2016). Moreover, DOST-Science Education Institute (SEI) and University of the Philippines National Institute of Science and Mathematics Education (2011) consider SIPs to develop scientific persons, by engaging the students to become curious, apply concepts and skills, and appreciate how science impacts the society. DOST-SEI further emphasizes that SIPs can provide effective medium in the development of S&T consciousness among the youth, promote public understanding and appreciate scientific breakthroughs, and improve the quality of S&T in the country. Through the conduct of SIPs, students are trained to become problem-solvers, critical thinkers and creative thinkers as they unlock the answer of their investigations (DOST-SEI & UP-NISMED, 2011).

Science Investigatory Project (SIP) Instruction

SIPs are considered instruments where students could contribute to the development of S&T in the country, as reflected in the content of these projects. These projects are creations of scientific knowledge, as well as the generation of new knowledge; have socio-economic relevance to livelihood development; and contribute to the advancement of S&T, and progress in the community. Science teachers embed the teaching of the SIP content in the curriculum, which helps the students conduct original work, understand the problematic and contentious nature of science, and be immersed in hands-on, minds-on tasks (Cuartero, 2016; DOST-SEI & UP-NISMED, 2011). As students immerse in these project-based tasks, they undergo a rigid process of translating their curiosity into a workable hypothesis, then experimentation and verification, thereby providing the curriculum an authentic means of assessing scientific concepts and principles (Sambeka, Nahadi & Sriyati, 2017).

Furthermore, SIP instruction does not end in the classroom alone. Student engagement in science fairs sponsored by the school conventionally follows. Research outputs are showcased (Tortop, 2013) where students convene to present their science studies, and undergo a question-and-answer process as a way of helping them refine their projects and assess their science knowledge utilization. To encourage them to make quality SIPs, education agencies organize science fairs as venues where academic competition in the basic education is exercised (Ndlovu, 2014). Winning SIPs shall compete to further levels, such as the regional and national levels.

Instrumental in the SIP instruction and assessment are the science teachers whose strategies and techniques paved way for the students to conduct SIPs and join science fairs (Mascarelli, 2011). However, the journey of the teachers in SIP-making and science fairs has not been explored in read literature. As such, it is very significant to take into account their experiences and stories as they consciously and unconsciously develop the research skills of the students, and train them for science fairs. These experiences and stories can be understood through anchoring the study on Bruner's paradigmatic cognition model (1986). The paradigmatic cognition explains that there are networks of concepts which provides people to construct experiences through highlighting common attributes that frequently appear (Polkinghorne, 1995). Bruner's model underpins the study as the stories of science teachers were obtained in order to make meaning of their role in the SIP instruction process. Thus, the paper sought to explore these teacher experiences in order to provide a deeper understanding as to how teachers contribute to the development of S&T culture in basic education, hence the conduct of the study.

Purposes of the Research

The study aimed to investigate the journey of the selected science teachers in implementing the SIP instruction and in contributing to the development of the science research culture in the secondary schools. Specifically, it sought to (a) determine what motivated science teachers to implement SIP instruction (b) describe teachers' SIP instruction implementation process, and (c) unveil their science research commitment.

Methodology

Research Design

The study utilized the narrative research design in order to determine the teachers' instructional practices on SIP instruction and science fair preparation, as well as their commitment to develop science research culture in schools. Specifically, the study employed the analysis of narratives where the stories of the science teachers were taken into account in order to make meaning of their role in the science research culture in schools. Using the teachers' experiences as approach in research could promote critical reflection on the life, and a sense of voice and self which could be understood deeply and multi-layeredly (Hickson, 2015).

Participants of the Study

Purposive sampling selected the respondents of the study. These respondents were science teachers from six identified schools in one Division in Central Visayas, Philippines (these schools have been competing in SIP production and presentation in the last five years). Specifically, two science teachers from each of the identified schools, totaling 12 teachers, were the respondents of the study. Selection process used the following criteria: (a) graduates of science-related baccalaureate degrees, (b) teachers of SIP instruction for at least five years, and (c) winning coaches of SIP, at least in the division level, in the last five years.

Table 1 shows the demographic profile of the respondents of the study. The majority of the respondents were graduates of Secondary Education, major in General Science, have more than 10 years of science teaching, and had at least five wins in Division Science Fair.

Table 1. Demographic profile of the Teacher participants in the study

Personal Information (N=12)	f (%)
Bachelor's Degree	
Bachelor of Science in Biology	1 (8.33)
Bachelor of Science in Chemical Engineering	2 (16.67)
Bachelor of Secondary Education, major in General Science	8 (66.67)
Bachelor of Secondary Education, major in Biological Science	1 (8.33)
No. of Years Teaching SIPs	
5-9 years	4 (33.33)
10-14 years	5 (41.67)
15-19 years	1 (8.33)
20 years and above	2 (16.67)
No. of Years Coaching SIPs	
5-9 years	5 (41.67)
10-14 years	5 (41.67)
15-19 years	1 (8.33)
20 years and above	1 (8.33)
No. of Wins in the Division Science Fair	
5-9 wins	4 (33.33)
10-14 wins	3 (25.00)
15-19 wins	3 (25.00)
20 wins and above	2 (16.67)
Fields with Most Wins	
Life Science	10 (83.33)
Physical Science	2 (16.67)
Robotics	0 (0.00)

Since the study involved human subjects as participants, the researchers sought permission from the University's Ethics Research Board, wherein informed consent was submitted and the paper was reviewed and evaluated. Moreover, the researchers assured the participants of their anonymity in the study, as well as of confidentiality of the data they gave.

Research Instruments

The study utilized two research instruments, namely demographic survey questionnaire and interview guide that were validated by one internal and one external experts on research instrumentation. The demographic survey questionnaire determined the profile of the teacher participants, including their educational background, teaching experience, SIP coaching recognition, and fields of interest. The interview guide directed the researchers towards gathering pertinent details essential to the understanding of the secondary school's journey in SIP implementation. The guide has four parts that include (a) personal background about SIPs, (b) knowledge and pedagogy in teaching, (c) motivation to teach and preparation for science fairs, and (d) winning IP and coach and the science IP culture. Some of the essential guide questions are:

1. What inspired you to start engaging in science investigatory projects? What motivated you to start teaching science investigatory projects?
2. How do you teach science investigatory projects? How do you integrate basic research skills in teaching Science subjects?
3. What opportunities did you get when engaging in SIP instruction?
4. How do you prepare and train students for science fairs?
5. What does it take to become a winning SIP coach? What keeps you motivated in molding winning investigators?

Study Context

The researchers carried out the study in one Division in Central Visayas with six schools as the locales of interest. These six schools have implemented SIP instruction, produced quality outputs, and consistently won in science fair competitions, at least in the Division level, in the last five years. These schools have been identified based on the official results of Division science fair competitions provided by the DepEd division office.

The study used a demographic questionnaire and a semi-structured interview protocol in the data gathering. The interview protocol followed the three serial in-depth interviews developed by Seidman (1998). This protocol deals with the teachers' personal background about SIPs, then followed by an interview which deals with the teaching practices on SIP instruction and science fair presentations. The third interview merges the data obtained from the previous ones to describe the individual stories of developing a science research culture in their respective schools. All of the interviews were audiotaped to efficiently collect all the information.

Data Analysis

The research utilized Polkinghorne's Analysis of Narratives (1995) to analyze the data gathered from the audiotaped interviews. Polkinghorne's analysis emphasizes the formulation of concepts that lead to categorical identity to the specifics derived from the gathered data. The analysis started with examining the life stories for common ideas. Then, coding schemes were designed to categorize data into groups of common themes. Moreover, these grouped data were inspected to identify attributes that defined them as part of the category. Lastly, the particular themes derived from such analysis form a story.

Results

Themes Generated From the SIP Teachers' Journey

Seven themes emerged from the analysis of narratives from which responses to the study queries may be drawn from Table 2.

Table 2. Themes Generated from the Analysis of Narratives

Generated Theme	Non-verbatim Response with Frequency	Selected Codes and construction	Descriptions of Themes
1. Prior Background in SIPs	First hand experiences in high school. (7)	• Experiences in high school (P3, 4) • First hand experiences (P5, 3)	Prior experiences concerning SIP making motivated the teachers to teach SIPs.
	SIP is challenging that it made them use higher order thinking skills. (6)	• Challenging that I learn a lot (P7, 11) • Challenges my critical thinking (P11, 5)	These are challenges that made them inspired and motivated to engage in SIP teaching.
2. Research vis-à-vis Scientific Method	Basic research skills are integrated through the discussion of scientific method. (12)	• Problem-solving (P3, 14) • Competencies on science process skills (P5, 10-11) • Scientific method integration (P7, 13) • Investigative activities (P9, 16)	Teachers taught research through the use of scientific method in problem-solving and investigative processes.
3. Challenges in the Supported Curriculum	There is lack of research infrastructure in basic education. (12)	• Technologies count (P1, 16) • Lack of facilities (P2, 20) • Financial support (P4, 22)	In SIP making, one of the biggest challenges was the lack of facilities such as computers, libraries and laboratories.
4. Coaching as a Motivation	Coaching has its opportunities for career promotion (5), travels (10) and recognition (12).	• Free, sponsored expenses (P1, 26) • Perks of being a winning coach (P2, 38) • To become science researchers (P9, 34) • Positive feeling (P10, 36)	Teachers are motivated to coach due to certain opportunities.
5. Research Skills Enhancement vis-à-vis Values Formation	Science character is developed through SIPs. (11)	• Resourcefulness and creativity (P1, 18) • Patience and perseverance (P2, 34) • Determination to read updates (P7, 27)	Teachers highlighted the importance of values in the conduct of SIPs.
6. The Reflective Teacher	Attributing conduct of SIPs to the reflection that Science is important in the society. (12)	• Science is a solution (P2, 1) • No advancement of civilization without Science (P11, 1)	Teachers' conduct of SIPs is reflective of the role of Science in the society.
7. The Global Teacher	Role of teachers in SIP justify their place in the S&T community.	• Molding scientists (P3, 26) • Instrument in S&T (P6, 28) • Justification of being a Science teacher (P7, 31)	Science teachers' role in SIP justifies their essence as instruments in the S&T community across the globe.

Prior Background in SIPs

The participants identify that the personal experiences of Science teachers in making SIPs during their high school life contributed to the manner that they teach SIPs in their respective schools. In fact, one teacher says,

> *"When I was in my high school years, our school promotes research-based projects ... the joy I gained and enjoyed from these years made me more engaged in IPs when I started teaching Science." (P3, 4-6)*

As SIPs are authentic tasks, and such tasks simulate the activities in the bigger world that, teachers also experience certain challenges in SIP engagement. A participant explicitly affirms this,

> *"Personally, Science IP challenges my critical thinking in many ways. My mind then wonder[s] for possible SIP at the beginning of each year level. Due to this, I teach SIP by encouraging my students to think outside of the box." (P11, 5-7)*

Though, teachers consider these challenges as inspiration to teach skills in SIP-making. This inspiration is seen in the extent of the teaching of critical thinking skills and "outside of the box" mindset to their students. When they integrate these skills in the research process, they become confident and motivated in teaching SIP, and lead them to be committed to SIP implementation.

SIP Instruction Implementation

Research vis-à-vis Scientific Method

The participants note that the application of inquiry skills, i.e. research skills, are not explicitly stated in the coursework,

> *"Since we don't have research subjects or at least competencies, basic research skills are integrated in the first quarter where competencies in science process skills and attitudes were described." (P5, 10-11)*

Teachers teach basic research skills to the students through the application of process skills and attitudes as integrated in a process called scientific method. A key participant highlights the skills integration in scientific method,

> *"Since SIP making calls for scientific method integration, I introduced to my learners the different steps, one at a time and make sure that they have daily outputs about it." (P7, 13-15)*

In undergoing the scientific method, teachers identify the first step as the primary, yet most crucial phase in SIP-making. This step involves the identification of the problem and the formulation of a solution,

> *"Everything should start at the basic: let the students identify the problems in their locality and I would ask them how can they help for these problems to be mended." (P3, 13-14)*

Moreover, finding possible solutions offers a venue for them to apply one basic skill that they should possess to become scientifically literate. The teachers identify this process skill as the gathering of pertinent information about the possible solutions vis-à-vis the problem,

> *"Teaching the students how to read books and journals is needed in the process of project-making […] Due to time constraints, I cannot check the sources of the information that they include in their paper." (P8, 35-36)*

Teachers attribute the failure of checking the reliability of electronic sources to the limited time of SIP-making, which only covers a grading period to accomplish in order for the SIP to compete during the Science and Mathematics month traditionally and actually held in September. Once information gathering is done, planning of the things to do in the Experimentation phase follows. In this stage of SIP-making, teachers point out that they let the students plan experiments, and they only supervise the carrying out of the experiments,

> *"I let the students read IPs in previous Bato Balani magazines and adapt the methods which can be best applied to their studies […] Of course, I tell them to cite the authors." (P10, 34-37)*

As methods are adapted and validated from published researches, they can just supervise their students during the conduct of the experiments. After such phase, the students record, present, interpret, analyze and discuss the results obtained from the experiments. These activities are vital in providing answers to the study questions, that teachers sit with them,

> *"When students tell me that they're about to carry out their methodology, I sit with them and tell them the data needed by the study […] Once they have the data, I sit with them again to guide them in interpreting and analyzing the results of the study." (P11, 30-33)*

Findings, conclusions and recommendations sprout from the study results. When students reach this phase, teachers experience a feel of relief as they only teach one research skill,

> *"If results are already analyzed, then students can now get the findings of the study, the conclusion and the recommendations through a synthesis. If*

> *this happens, I feel a sense of relief and joy since I know we are almost there." (P3, 39-41)*

This accomplishment illustrates the complementarity between research and scientific method as the way science teachers integrate basic research skills when students undergo the method, hence offering a venue to the development of science research culture in the secondary education.

Challenges in the Supported Curriculum

The journey of the science teachers in implementing the SIP instruction is not without challenges, particularly in the supported curriculum. Teachers highlight the most common problem such as the lack of computer facilities, functional library, and laboratory resources,

> *"Among the challenges encountered is the lack of facilities: our students lack access to available laptops or computers." (P2, 20-22)*

> *"We don't have a functional library. There may be books but these books aren't updated." (P1, 16-17)*

> *"We don't have the facility like a laboratory equipped with the apparatus that we need. There is no budget from the school." (P11, 19-20)*

Computer facilities are needed for the SIP process in order to gather relevant and updated information thru the use of Internet. Library resources like books, periodicals and documentaries are valuable assets of the academic community, and as such, these should be readily available for use by the students. The availability of laboratory resources in schools such as apparatus and chemicals could help in SIP-making as these become accessible to the students; and these can lessen the cost spent by them. However, this is not the case as revealed by the same participant,

> *"Since there is no facility in school, we rely on outside laboratories such as in DOST or DA that could provide minimum expenditures. But when a lot of people use their labs, we go to private labs for experimentation, which require us to shell out resources from our pocket." (P11, 21-24)*

Due to the lack of laboratory resources in schools, science teachers reveal that they use their own finances, and opt to go to commercial laboratories for experimentation and analysis. Library, laboratory and computer facilities support the implementation of SIP instruction in the science curriculum, thus, are essential scaffolds in the science research culture.

Coaching as a Motivation

SIP instruction includes coaching students for science fair competitions. To prepare them for these competitions, science teachers also train them. They recognize that question-and-answer drills are the first and foremost means of preparing the students,

> *"Once IPs are ready, researchers are exposed to interrogations to assess what they've done and will be trained to respond as scientists." (P2, 28-30)*

Moreover, during science fairs, evaluators roam around to examine the research outputs whether the students know how these outputs are made and manipulated. With this in mind, teachers also train them to perform laboratory techniques,

> *"Identified researchers perform laboratory works using proper techniques as part of their preparation for science fairs." (P2, 26-28)*

If mastery of content and lab techniques is observed during the science fair competition, then there is a greater chance that SIP will land a place in any competition level. When an SIP wins, students could present and defend their project in regional, national or even in international level. Since higher standards are expected, teachers further prepare and train students,

> *"Thorough checking of the research the logic and coherence of the paper. Then, I invite some experts outside to help in giving critiques to the students." (P11, 24-25)*

Training for further competition is more rigid, and seriously taken by teachers than the previous one. Teachers persevere to win in these competitions because of the opportunities,

> *"Being recognized as Best Coach opened an opportunity for career promotion." (P5, 14-15)*

> *"Learn new things. Get to travel to different places." (P6, 16)*

Teachers were motivated to become winning SIP coaches due to certain factors: intrinsic factors to keep producing quality projects, and extrinsic factors such as career promotion and travel optimistically looked forward every school year.

Research Skills Enhancement vis-à-vis Values Formation

Teachers emphasize that the key components in SIP process are intangible attributes that motivated them to integrate SIPs in the curriculum,

> *"Resourcefulness, and creativity are some values learned. I also widened my horizon in the field of research." (P1, 18-19)*

The abovementioned attributes lead the teachers to inspire the students to exhibit persistence,

> *"It takes patience and perseverance in training these students to become science researchers; determination and optimism to inspire then students to never give up; and dedication to attain their goals." (P2, 34-36)*

Teachers point out that to inspire students is to inculcate the scientific values and attitudes and to develop the scientist character. This character among students become the highlight of becoming a winning SIP coach.

Commitment of Science Teachers to Implement SIP Instruction

The Reflective Teacher

The perception that science is important in the society paves way for science teachers to be committed to SIP instruction,

> *"There would be no advancement of civilization without science. Without science, we cannot enjoy the technology we have today." (P11, 1-2)*

When teachers are committed, they guide the students in producing projects that can benefit the society. Also, teachers credited their commitment to the problem-based nature of SIP instruction,

> *"Science is a solution… through proper application of science concepts, the community is given options to resolve health and environmental issues." (P2, 1-3)*

Through the search for possible solutions for community problems, teachers make SIP instruction relevant and meaningful for the students. Hence, they justify the importance of science in the society through SIP-making,

> *"We need SIP since science is a continuous process. We need to get updated, thus, we continue to investigate. Science and technology are rapidly evolving, so we need to get track to avoid being outdated." (P12, 2-6)*

Through SIP-making, teachers and students both reflect that "Science is life", and in order for science to continue existing, SIP culture should also be developed in the journey of secondary schools.

The Global Science Teacher

Secondary science teachers contribute to the development of science research culture in basic education where they provide means for the students to give something to science,

> *"Molding scientists who are critical and creative thinkers who could solve the problems that require science." (P3, 26-27)*

Most importantly, the role of teachers in SIP instruction is pointed out to be critical in the scientific community,

> *"The drive that I'd be able to leave a legacy to the students. I was able to make justification being a "science teacher." (P7, 31-32)*

The roles of teachers in SIP instruction justify the important place of science teachers in the scientific community. The "science teacher in me" description among the respondents justify their essence, as they respond to the cascading of science goals to the studentry.

Discussions

Experiences prior to the teaching of SIP have an impact on how teachers implement SIP instruction. As teachers are exposed to realistic projects in their previous educational levels, they gained more grasp of how SIPs should be taught to the students. Realistic projects as tools for authentic assessments enhance student involvement in the learning experience (Vu & Dall'Alba, 2014). In making such authentic assessments, teachers guide students to use critical thinking skills and "out of the box" mindset. Integration of these skills in the teaching of SIP reflects how science teachers effectively implement project-based tasks (SEI, DOST & UP-NISMED, 2011). As such, teachers should have strengthened knowledge and skills in research, not only during high school, but also during their undergraduate studies and even in post-baccalaureate studies. There should be strengthening of research in science education curriculum among universities and colleges, since prior experience impacts how they teach SIP in the basic education (Mansour, 2009).

The K to 12 Basic Education Curriculum aims to apply scientific inquiry skills for the students to solve problems and innovate for beneficial products (DepEd, 2016), wherein the curriculum should explicitly embed research skills in the science coursework. Such coursework integrate research skills as means of solving problems in the community (Dogru, 2008; DepEd, 2016). Since problem solving requires careful investigation, it should include steps in order to arrive at a certain solution, in a process called scientific method (Glazunov, 2012). For teachers to teach SIP vis-à-vis research and scientific method, teachers should be adept with how such process is done, and how this process should/may be taught to the students. Science teachers should be adept in teaching how students may source problem, identify the validity and reliability of read literatures, and ensure the ethical adaptation of validated and published experimental methods, analysis and interpretation of data, among others. Thus, the science research capability of faculty members should be strengthened through seminar-workshops and conferences.

Moreover, the supports to SIPs are important scaffolds in the instruction implementation. Journal articles related to the students' projects are archived online; thus, laptops, wifi and educational softwares are indispensable tools in schools (Singh, 2016). The challenges in supported curriculum do not rest only on computer and laboratory resources. Due to the lack of laboratory resources in schools, science teachers revealed that they use their finances, and opt to go to commercial laboratories for experimentation and analysis. The use of commercialized laboratory testing and analysis, though considered an invalid practice, is viewed as an acceptable practice by teachers because there is lack of laboratories in basic education schools, as well as the desire to obtain accurate results (Jugar, 2013). Therefore, the presence of functional facilities in school is needed for a successful conduct of SIPs by students and teachers.

Science teachers train students disseminating SIP results during science fairs through project presentation and displays. They train students by asking them possible questions, which may come out during competitions, and aid them to correctly respond to the questions. Interrogation drills ensure the success of defense in any science exhibits (Liu, 2006). When an SIP wins, students could present and defend their project in regional, national or even in international level. Training for further competition is more rigid, and seriously taken by teachers than the previous one. Instead of just practicing the interrogation and lab technique drills, they also re-examine the SIP for errors and non-coherence, and integrate the comments given by the evaluators in order to improve the paper. The first placed coaches invite external evaluators to double check the paper, and to enhance students' answering skills and confidence when they present and defend in the more competitive (Hayward, Laursen & Thiry, 2017) venues. This finding implies that teachers should be exposed to coaching capability trainings to enhance their advising skills. Also, linkages to external experts should be obseved by schools to guide the winning students and coaches for further competition.

Furthermore, learning new things and development of career values contributed to the personal and professional development of teachers immersed in SIP-making (Wilson, Schweingruber & Nielsen, 2015). This leads them to inspire students to exhibit science attitudes and values. Teachers inculcate these attitudes and values to develop the scientist character. The development of the scientist within the students is a perk among teachers that cannot be taken away by other people, as students attribute their scientific character from their science teachers (Sheldrake, Mujtaba & Reiss, 2017). The scientific character among the students become the highlight of becoming a winning SIP coach. It is with what the teachers have contributed to the affective domain of the budding scientists that persuade them to be successful in SIP. This emphasizes the importance of the affective domain in the development of science research culture in basic education.

The commitment of science teachers towards SIP instruction implementation makes them reflective and global teachers. When they reflect upon the importance of science in the society, they continue the investigative nature of science and the innovative characteristic of technology, while their students commit to the continuous search for solutions to problems in the community. In this way, teachers endeavor to mold critical and creative thinkers, as well as to produce scientifically literate citizens in the general public. These scientific minds will soon compose the scientific community, ensuring the continuity of the pursuit of scientific discoveries and innovations which can eventually help the country (DepEd, 2016). To remain committed to the investigative and updated nature of science, teachers should infuse innovative teaching strategies that could draw out the science character among the students, and should provide up-to-date information concerning S&T topics so to sprout innovations critical to the 21st century arena.

Implications of the Study

The study was conducted to investigate the journey of science teachers as they implement SIP instruction in schools. The themes derived from the analysis of narratives are essential in filling the gap in the literature that sought to determine the development of science research culture in secondary schools through the lens of the teachers' experiences, instructional practices, and commitment.

The journey of the secondary schools in SIP instruction is primarily held by the science teachers' endeavor to instill basic research skills to the students. Factors such as prior background, teaching strategies, and supported curriculum have significant contribution on how teachers teach SIP in the science curriculum. Moreover, the role of the teachers as coaches for Science fairs paves the dissemination of research outputs to the community and the country.

In the SIP implementation process, students do not only acquire knowledge and skills, but they are also inculcated with values and attitudes essential for the understanding and appreciation of the improvement brought about by Science. This values and attitude development leads to the creation of a "Science character" in themselves, which is crucial in the improvement of S&T in the country. Hence, science instruction should include inspiring stories of scientists and inventors to spark such character, and integrate creative and critical thinking tasks. In this way, they become reflective and committed to the improvement of S&T in the country.

Furthermore, science teachers are instrumental in the SIP instruction process. They contribute much to the development of science research culture in basic education, thereby justifying their roles not only in the school system but also in the wider scientific community. In this way, they provide means to cascade the science research goals to the studentry, wherein students are involved in the activities of the scientific community. Thus, teacher trainings in research, and research infrastructure in schools are deemed essential in helping them in accomplishing this cascading process in basic education.

Since teachers play a vital role in SIP instruction, it is recommended that they should guide the students, not only in the conduct of their projects, but also in the planning and assessment phases. SIP instruction is primarily based on scientific method and research, then, it should be taught using the steps of scientific method, and be integrated with basic research skills in order to make SIP process successful. To make SIP process more successful, the government and private administrators should create research infrastructure in basic education to provide access to vast information in print and electronic resources.

The study is limited to determining SIP instruction process according to the lens of science teachers in one Division in the country. Future researches may deal with the SIP process using the perspectives of the students and administrators to provide a holistic understanding of SIP instruction implementation in the curriculum. These perspectives may lead to generation of a theory that manifests how institutions of basic education build science research culture.

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