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SCIENCE EDUCATION IN THE PHILIPPINE COUNTRYSIDE: A PHENOMENOLOGICAL STUDY

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Abstract

The study was designed to explore the science education in the Philippine countryside. Using phenomenological approach and in-depth interview method, the study found out that the science education in poor provinces of the country is weak. There were issues on insufficiency of science infrastructures (e.g., laboratories and internet), out of field teaching, poor reading comprehension, and poor moral of teachers that contribute to the weakening of science education in the countryside. Hence, it is recommended that education managers of the country must solve these issues in order to lessen the burden of teachers and raise the system of science education of the nation.

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INTRODUCTION

Science being a body of knowledge needs refinement to meet scientific needs of society. The task of refinement is the mandate of the educational education institutions of the country in a way as to make it responsible in diffusing the benefits of science to the people. However, science education in the Philippines is beset with many challenges. This is probably attributed to the country's low investment in higher education compared to its ASEAN neighbors (UNESCO, 2015). Further, in terms of global competitiveness, the country has but ranked between from 55th to 59th out of 63 countries during the years 2011 to 2017 (Global Competitiveness Report, 2017; as cited by DOST, 2017).

According to Al-Samarrai (2016), Philippine school teachers are but proficient in less than half of the test on content subjects, and the Philippine Institute for Development Studies (2009) pointed to the root causes failing education system as lying on weak governance, political discontinuity, and lack of accountability. Another issue that challenges Philippine development goals is the trend of focusing more development in the urban areas and neglecting or providing, if any, just meagre development assistance to the rural parts of the country.

This research is initiated to explore science education in the countryside through the eyes of people engaged in implementing science competencies, such as the teachers. Much of the studies on science education have been conducted through quantitative research approaches, and studies using qualitative methods are practically nil. Thus, this study could serve as pioneering research of its kind.

METHODOLOGY

Research Design

This research follows a qualitative research design to explore the science education in the countryside. The phenomenology approach was used in this research in order to explore the lived experiences of science teachers in the Philippine country side in terms of science education. According to Davidsen (2013), phenomenological study is important in discovering and explaining the reason for the existence of the experience.

Under this design, the study used in-depth interview to meaningfully acquire the issues, problems, challenges, and strategies of the science teachers. According to Englander (2012) in-depth interview provides richer insights into the experiences of people who lived into such a phenomenon.

Participants

The science teachers from three of the top 10 poorest provinces of the Philippines were the participants of this research. These provinces were selected purposively to reflect the countryside science education in the Philippines. There were 20 participants who were all science teachers with minimum of five years in teaching service. These teachers were all part of the basic education sector under the Department of Education (DepEd). Many authors consider 5 to 50 participants as requirement for data saturation in qualitative study (e.g. Boyd, 2001; Dworkin, 2012).

Data Collection

Before the interview started, a semi-structured interview guide was made. This kind of interview structure allow for greater collection of participants' thoughts, aspirations, and feelings about the topic (DeJonckheere & Vaughn, 2019). There were two main questions asked to the participants. First, they were asked about the issues of science education that they encountered in their classroom. There were follow up questions if the answer of the participant can be expounded or made clearer. For instance, one of the follow up questions was their strategy in bridging the gap about such raised issue. The last question was about a suggestion on how the issues in science education should have dealt with by the government.

As a courtesy, the study asked the permission from the school superintendent of the division office through a formal letter. On the letter, the purpose of the research was included and the limitations of the interview. Upon approval, the

letter was copy furnished to the school principals where the study was conducted.

The research goes to the individual participant for interview. Before the start of the interview, they were asked to sign the informed consent form. If they sign the form, then the interview will start. On the other hand, if the person will not sign the informed consent form, the next person on the list will be interviewed. In addition, the participants were also informed that the data will be kept confidential in every part of the research process.
The interview data were audio-recorded so that the researchers can have a reference if the transcript is not clear. These audio-recording were fully transcribed in order to catch all significant points discussed by the participant.

Data Analysis
This study utilized the protocol of Braun and Clarke (2006). The first step was becoming well-verse with the data, hence; the study used researcher derived codes to generate the themes to have familiarization with the transcripts. The interview transcripts were also read very carefully in order to gain the significant insights. Then, after reading the statements, the researcher generated initial code by differentiating transcript with data saturation and those without. However, at the start, the researcher considered all interview data to have equal value, a process called horizontalization as suggested by Moustakas (1994).
The next step was to search for the themes. In this process, the coded transcripts were given significant statements and subtheme, then given a theme. The fourth step was reviewing the derived themes wherein the researcher looked into the significant statements or subtheme that overlaps each other. If this occurs, these were clustered in one overarching theme. If there were no more overlapping and common themes, the overarching themes are now defined.

RESULTS AND DISCUSSION

Overall Theme: Weakness of Science in the Philippine Countryside
The weakness of science education in the countryside of the Philippines is brought about by: (1) insufficient science instructional facilities; (2) out-of-field teaching in science education; (3) student factors; (4) science instruction inadequacy and (5) poor reading comprehension.

Theme 1: Issues in Science Education
The first emerging theme is "Issues in Science Education". There were three subthemes that manifested from the science teachers' experience; these include (1) insufficient science instructional facilities, (2) science instruction inadequacy, and (3) student factors.

Subtheme 1: Insufficient Science Instructional Facilities
Science teachers in the Philippine countryside narrated about the difficulty of teaching science with lacking instructional facilities, especially the laboratories and computers. The following statements support this subtheme.

"The issue related to science education that I encounter; one is insufficient laboratory materials and laboratory tables." – Teacher 1, transcript 1, page 1, line 2-3

"Sadly, the truth is we lack the materials needed for science education especially when it comes to experiments which are badly needed in the class. I believe students will have conceptual understanding of science concepts if lab facilities are utilized in the school." – Teacher 2, transcript 1, line 9-10

"Teaching is not easy; there are only limited facilities and resources in the school." – Teacher 1, transcript 1, line 38-39

"We lack the facilities such as laboratory equipment wherein this is so very important in conducting some activities but due to the insufficient supply of this equipment." – Teacher 6, transcript 2, line 48-49

"We're lacking in terms of science laboratory facilities specifically in terms of or maybe in physics laboratory it." Teacher 7, transcript 2, line 56-58

"The inadequate of computers and other technologies, we all know that in this generation

technology is ubiquitous." – Teacher 6, transcript 2, line 50-52

The issue on insufficiency of science facilities has been reported for so long a time in the country (e.g., Nielsen, 1983; Ambag, 2018). As early as 1980, reports showed that there was insufficient number of such facilities in the Philippines (Nielsen, 1983). Though the country placed big amount of its national appropriation in the Department of Education (DepEd), this seemed not enough to create even a one is to one student to computer ratio or even one per school laboratory for physics, chemistry, and biology. UNESCO, through its website, reported that the Philippines government expenditure to primary, secondary and post-secondary non-tertiary education was the average of the all countries surveyed under the World Education Indicators (WEI) while the private institutions in the country invest eight-fold on education than the government. Based on this website, there was also decrease in government expenditure on education as percentage of the gross domestic product since 2004-2009.

The problem on science laboratory facilities can worsen the learning of science in the Philippines. In fact, the Philippines is already lagging behind in science education based on the 2003 Trends in International Mathematics and Science Study (TIMSS) which reported that the country placed 42 out of the 45 countries surveyed in eighth grade science (Virola, 2007). Moreover, Cordero (2018) reported that the country flunk to reach the average score of 500-level in the Programme for International Student Assessment (PISA) and the TIMSS in 2013. This problem can be attributed to the lack of laboratory facilities among schools in the Philippines especially in the countryside. Based on the Dale's Cone of Experiences, students have fruitful learning experiences when they act and do the activity, such as doing an activity using science laboratory facilities.

The use of the laboratory facilities in the classroom can effectively inculcate good science process skills among students unlike in the traditional chalk and talk method. The study Hirca (2013) found out that hands-on laboratory activity can enhance the achievement of physics competency among the students. Dohn, et al. (2016) reported that physiology students recognized the importance of laboratories in learning difficult topics because it made the lesson easier to grasp. This literature supports Teacher 2's argument that laboratory facilities helped students gain scientific understanding inside the classroom. Moreover, Wilson and Flowers (2002) reported that teachers utilizing science laboratories in class have more confidence than those without laboratories.

Subtheme 2: Out-of-field teaching in Science Education

The participants talk about the issue on out-of-field teaching in science education. Out-of-field teaching connotes to the phenomenon of teachers doing teaching and learning process with students on a subject not of his/her bachelor degree (Ingersoll, 2000). The following statements support this subtheme.

"The lack of foundation with the basic sciences I think is a problem. Since the curriculum is spiral, you go through from grade 7 to grade 12. This means you must have the basic knowledge when it comes to this. This situation made me less confident in teaching other science topics." – Teachers 2, transcript 1, line 13-16

"My answer would be the implementation of K to 12 curricula which is spiral in terms of its topics and science teachers becoming a generalist." – Teacher 5, transcript 2, line 45-46

"You cannot basically teach higher concepts in science without the students knowing the very basic of science so that makes them difficult to understand science because of course the basic knowledge is not there." – Teacher 2, transcript 1, line 18-20

"I am biology major but I need to learn Physics and Chemistry because science curriculum is now generalist. This is brought by

the implementation of K-12 spiral curriculum. This made problem for me because I lack foundation of these other sciences." – Teacher 9, transcript 2, line 63-66

Science teachers in the countryside experienced lack of foundation in other branches of science. For instance, Teacher 9 narrated that even though he is a biology teacher, he must teach physics and chemistry but he cannot effectively teach the competencies of physics and chemistry. Majority of the participants blamed the existence of the issue on out-of-field teaching because of the spiral curriculum of the K-12 wherein a teacher is teaching the same topics (e.g., biology, physics, chemistry, earth science) in increasing depth and complexity. However, there is no current literature in the country that proved the effect of K-12 curriculum to the out-of-field phenomenon; much more in the countryside. In the USA, Jerald (2002) found out that schools with high poverty rate have also high out-of-field teaching phenomenon.

Moreover, even before the implementation of K-12 curriculum in 2012 in the Philippines, out-of-field teaching phenomenon has occurred for long. There is no new data on the scale of out-of-field teaching in science in the country. Mullis et al. (2000) reported that 60 percent of all science teachers in DepEd are out-of-field in 1999.

Teacher 2 manifested that he becomes less confident in the class because other sciences are not his forte. This fact is supported by McConney and Price (2009) and Hobbs (2012). Teachers may loss sense of confidence and self-esteem and even loss the passion for teaching (Hobbs, 2012). Teachers may fall to stress and depression because of becoming over loaded in studying a lesson new to them (McConney and Price, 2009).

On the part of the students, out-of-field teaching may impair students' achievement. Teacher 2 recognized that students may lack the foundation of sciences which will make them difficult to understand the concept. Dee and Cohodes (2008) argued that students have low performance when handled by an out-of-field teacher compared to the subject-certified teachers. Science achievements among 41% of grade 12 students in USA are being hampered because out-of-field teaching (Ingersoll, 1998).

Subtheme 3: Student Factors

Science teachers in the countryside observed that students with little scientific knowledge have low comprehension and retention, thus have no interest and some are slow readers. They detailed that students are slow readers and reading comprehension is low. Some emphasized that they become helpless and hopeless knowing that students did not learn something on that day. The following statements support this subtheme.

"In terms of teaching students, some students cannot really understand the topic and some have no interest and seriousness in the discussion of the topic." – Teacher 4, transcript 2, line 41-43

"I experienced that some students are slow readers and they have these difficulties in understanding the concepts in science." – Teacher 9, transcript 2, line 61-63

"Actually, there are many issues that I have encountered in teaching science and I believe the common is the low comprehension level of the student." – Teacher 10, transcript 2, line 69-70

"Most of us think that students do not have the appreciation towards science because simply they do not know or probably, they lack the knowledge about science." – Teacher 3, transcript 6, line 195-197

"You really follow everything, you teach them, at the end of the day you will just realize that you have done nothing, the students did not understand at all, so it doesn't make sense." – Teacher 3, transcript 7, line 246-248

Student factors like low reading comprehension, no interest, lack of basic knowledge, and low reading comprehension in science is a very frustrating phenomenon knowing that science classrooms should have been the light for creativity and innovation in the classroom. Since science is the body of knowledge, how can classrooms produce new idea if students have no interest in science topics.

Quantitative studies suggest that there has been a decline on students' interest in science in the recent years (Tobias, 1990; Jegede, 2007). However, in another Philippine province, the interest in science is also considered intrinsic among students (Libao et al., 2016). When students do not have interest, their performance will be affected also. They will not be able to participate properly in the classroom.

However, students cannot solely be blamed for their low school performance in the class since the teaching process is a three-way paradigm. The teacher and school environment can also have an effect to their performance. The Ohio State University (2015) firmly believe that learners cannot be blamed if they do not enjoy school since the genetic makeup of an individual can have an effect as well. The teaching style of teachers can also affect student interest in science class, for instance in statics topic (Komarek & Bielefeldt, 2015).

Theme 2: Remedies

Because of the issues on science education, the teachers in the Philippine countryside needed to cope in order to survive the daily ordeal of having lacking of science facilities, having students with no interest and poor reading comprehension, and having lack of other science foundation. In order to cope, teachers narrated about improvisation of materials and self-education of other science specialization.

Subtheme 1: Improvisation

Science teachers are improvising their materials and equipment in order to give students the competencies required. The following statements support this subtheme.

"I use improvised materials. During group work, I instructed my students to write their outputs on the floor using manila paper because of lack of laboratory materials. If they write on the arm chair, the space will not be enough." – Teacher 1, transcript 2, line 78-80

"So when it comes to the lack of science equipment and materials, I try to provide improvised materials for my students. Not necessarily the exact copy but somehow related to those activities that are being done." – Teacher 3, transcript 2, line 83-86)

"In my own ways, since there are limited facilities and resources, I intend students to have some advance research about the topic and I also give copies about the topic for them to cope with the topic discussed." – Teacher 5, transcript 2, line 107-109

"We sometimes make some modifications in order to suit and put things in order and I do some peer mentoring or shifting of major subjects." – Teacher 6, transcript 3, line 113-115

"In my case, if I do some laboratory activities but there is no available equipment in the school, I just do an alternative way for us to conduct the said activities." – Teacher 7, transcript 6, line 208-209

Teachers narrated that in order to cope with lack of science instructional facilities, they need to modify the curriculum guide since some materials stated in the guide are not found in their laboratory room. Teacher 1 exemplified that the lack of laboratory tables moved the class to use the floor to lay their manila paper to write their lab report. Reports of the lack of laboratory table in the Philippines has haunted the DepEd for many years now. Francisco (2015) reported through rappler that the government build 455 technology laboratories which will only solve a fragment of a problems since there are a total of 7, 917 government schools in the country. Hence, partylist groups in the country (e.g., ACT, Bayan Muna) call for the immediate action from the national government to solve the shortages of classroom, laboratories, and tables (Atienza, 2019). The national government should focus on procuring more laboratory facilities especially tables, as narrated by Teacher 1, the students are already using the floor for their experiment. Under the laboratory manual or procedure of schools, laboratory materials (e.g., alcohol lamp, Bunsen burner) should be placed properly on the table and carefully utilized by students for security purposes. If the learners will utilize the floor for their lab experiments and other activities, there might be accidents to arise in the future.

Moreover, the improvisation of equipment and materials is a sign of innovativeness among science teachers in the countryside. This kind of situation are common especially schools in the faraway places. Some teachers improvise because it is needed for suitability on the students learning style and preference. Teachers even opt to buy low-cost materials (Hirca, 2013). There are studies that found out that improvised materials can match what the standard material do inside the classroom (e.g. Onasanya & Omosewo, 2011). Improvised materials can also produce better motivation and achievement among students because of enhanced interaction with the material (Mboto & Udo, 2011). Therefore, this coping mechanism of the science teachers in the Philippine countryside is effective as far as the literature is concerned. However, standard equipment and materials can provide much effective learning atmosphere and untarnished security to students.

Subtheme 2: Self-Education

Science teachers experienced self-education in other areas of science because they are either out-of-field or specialized only in one branch of science. Teachers narrated about the difficulty they encountered because of the K to 12 science curriculum that brought science to become area specific per grading period and not year grade level specific, like the old curriculum. The following are significant statements cited by the participants.

"Because of the K-12 curricula we are to teach biology, earth science, chemistry, and physics. So, a science teacher today must know all areas of science. It will be difficult to enroll in other subjects so I need to study for myself." – Teacher 9, transcript 4, line 129-131

"I am self-taught somehow; I have to do it on my own and teach myself. I have to study by my own really just convey the message across my students whatever I learned from my self-study. I have to do it on my own." – Teacher 3, transcript 5, line 146-148

"In my case, I give more time to studying a particular topic which I have going discuss and I participate in peer mentoring." – Teacher 6, transcript 8, line 253-254

Teacher 9 narrated that it is difficult to enroll to a regular science specific major class because it would entail another financial and time resources. This difficult that science teachers encountered is common nowadays. However, teachers in the Philippine countryside take up this challenge and intend to double the effort in order to deliver properly to the students. Teacher 6 even narrated that he joined a peer mentoring activity.

In the professional education subjects (e.g., Principles of Teaching), it is part of the lecture that learning is a continuous process. This principle of teaching is clearly evident in the lived experiences of these teachers. The system of self-education began during teachers' pre-service training, it is already clear to them that teaching is researching and it is part of being a professional teacher (Cole & Knowles, 2000). Self-education allows teachers to think about their own thinking, improve on themselves, and plan a learning atmosphere that sustain interest among students (Austin & Senese, 2004).

Although, self-education is very vital part of learning, self-education that teachers are concerned in this study is brought about by the out-of-field teaching issue. It is still imperative that science teachers teach their own specialization for the students learning benefit.

Theme 3. Approaches Suggested

Along suggested approaches, three sub-themes emerged: suggestion for sufficiency of science laboratories, focus on reading comprehension, and diversifying teaching strategy.

Sub-theme 1: Suggestion for sufficiency of science laboratories

Participants exemplified their suggestion on sufficiency of science laboratories. Majority of the participants talked about a scenario if experiments are part of their discussion, then there will be emergence of conceptual understanding in class. The following statements support this theme:

"I think the government should provide sufficient laboratory materials and apparatus or

the government should provide sufficient fund for durable laboratory materials and provide laboratory tables in each science class." – Teacher 1, Transcript 5, Line 175-177

"If only the Department of Education provide us with the necessary things that would enable us to impart our knowledge in science with the help of those equipment and materials because really experiments do help us a lot." – Teacher 3, Transcript 6, Line 186-188)

"For one, because of the lack of materials, I had an experience that I was forced to buy science materials out of my own pocket. I wish the government must solve immediately this problem because our salary is only for personal necessities." – Teacher 3, Transcript 7, Line 230-232

The concern on insufficiency of science laboratories could be primarily caused by low investment in higher education by the Philippine government, compared to its ASEAN neighbors (UNESCO, 2015), affecting the global competitiveness of the country to be de-ranked from 55th to 59th out of 63 nations. This situation placed teachers in a dilemma whether to appropriate some of their salary for school purposes or not. Teacher 3 faced such experienced that he is already using his own money to solve insufficient of materials in their school. This will imply that teachers own salary is already being used for buying their school materials for instructional purposes. As issue on teachers' salary hunts the government, teachers extend help to diminish the effect of insufficiency of science materials by purchasing their own.

Sub-theme B: Focus on reading comprehension

Subtheme B talks about the experience of the participants on poor reading comprehension of the students. That is why they suggested that the Department of Education should focus on reading comprehension because students cannot comprehend science lessons. The following statements support this subtheme.

"In my perspective, in their elementary years and in junior high school years, the teachers should focus and give emphasis on the reading comprehension of the students. So, when they go to higher schooling, they will not have this difficulty in understanding the concepts of a specific subject specially science subject." – Teacher 2, Transcript 5-6, Line 177-181

"Before moving to higher academic learning, schools must not allow a pupil or student to graduate because it will be very difficult for them to understand complex subjects." – Teacher 4, Transcript 6, Line 196-198

"I suggest that schools must emphasize reading comprehension for pupils and students so that when they are in the senior high school or even in college, there will be small difficulty in teacher hard sciences." – Teacher 7, Transcript 7, Line 257-260

The problem of reading comprehension difficulty is similarly felt in other parts of the Philippines. In Cotabato, Philippines, Imam, Mastura, Jamil, and Ismail (2014) found that the overall performance in reading comprehension and science among first year was at low mastery level. Some intrinsic factors on personal motivation may contribute to this difficulty. In learning the second language—that is, English, Blay, Marcado and Villacorta (2009) have found the factors of competition and challenge as the motivating force among the Grade 4 learners in the language.

If students are exposed to certain positive reading comprehension strategies in their previous learning experiences, then in the latter time their performance in science would be positively felt. Iman (2016), for instance, have found that linguistic skills such as making inference, getting the main idea, noting details, and contextualizing vocabulary—all these could predict better learning in science and mathematics. Even problem-solving strategies, according to Ilustre (2011), also enabled students to gain higher scores in reading tasks.

Therefore, the data implied that teachers are faced with heavy burden of teaching students with poor reading comprehension. Although, it is imperative that teachers must cure student's

deficiency, sometimes it is difficult to cure a disease when it is too matured. Hence, DepEd must strategize, especially during kindergarten and elementary, mechanism that will promote reading comprehension about students. This calls for an immediate action because international surveys reveal that the country is pacing far beyond in ASEAN in reading comprehension.

Subtheme C: Diversifying teaching strategy
Subtheme 3 is about diversification of teaching strategies in science. The following statements support this theme.

"I'm not focusing on one type of strategies for example, some may understand the teachings but not all learners can come up with the same ideas. It means that the strategy you currently use is not applicable to all the learners. So, I challenge myself to improve more in my strategies." – Teacher 7, Transcript 7, Line 244-247)

"Teachers should vary their teaching strategies in order to meet all needs of the learners." – Teacher 10, Transcript 6, Line 223-224

"In determining the learning styles of the students, it is now the teacher turns to use the different methods. We have this so called "modeling and experimentation" a kind of activity so that the students may can get this as another source of information to use another kind of learning method." – Teacher 4, Transcript 6, Line 193-196)

The factor of diverse instructional strategy in teaching science need not be over-emphasized. It is primordial to creating an attractive environment that must naturally cultivate interest among the learners. Lopez (2007) has confirmed that student performance did improve much from a technologically-enriched classroom along with the concomitant teaching capacity. Pacala (2021) argued that combining teaching active learning strategies can help boost learning in the class. In a local study, he presented data about the effect of computer simulated supported predict observe explain in eliminating alternative conceptions and greater autonomy of students in learning.

The lowering of the quality of education in the Philippines, particularly in basic science subjects, could be attributed to the "mass promotion" mentality that has emerged from the no-child-left-behind (NCLB) policy of the country's Department of Education (DepEd). The NCLB strategy which was imported into the country from the United States (US) has been reported to be a failure program in its country of origin along the following areas: (1) for its unequal implementation, (2) for having a "faulty measurement capacity", (3) for lack of qualified and quality teachers, (4) for lack of parental involvement on school concerns, and (5) for undermining the capacity of communities in its role as partner in issues concerning low-performing schools (Stanik, 2007). Thus, by copying the program from the US, the Philippines has also replicated its failure into the country's educational system. This pathetic outcome probably explains the condition of mediocrity that characterize the current batch of senior high school and college students.

CONCLUSIONS AND RECOMMENDATIONS

The nation's countryside experienced weakening in its science education. It is evident since participants narrated about insufficiency of science materials and out-of-field teaching. The poor reading comprehension of the students contribute to the declining interest in the subject and failing standard in science education.
Teachers, who implement the science standards, are troubled because they became out-of-field teachers due to the implementation of the K-12 curricula. They need to study other science subject out of their specialization. Teachers are worried because they buy their own school materials instead of utilizing their salary solely for personal needs and necessities.
Therefore, the educational managers of the country, especially of those in the top, must place mechanisms to solve these issues of science education in the countryside. It is of utmost importance that solving these problems must be given priority before it is too late. Schools should be given laboratories for concrete purposeful experience of science topics.

The education department should implement policies that lead to comprehension of even just literal level even before graduating the elementary. Finally, parents must share their part of helping their children and not put all to the teachers.

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