

A Literature Review Towards Pre-service Science Education Policy

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ABSTRACT

Science education in the Philippines seems to be in the loop for so many decades as results of national (NAT) and international (TIMMS and PISA) assessments showed poor performance of students in science. In the study of Moyle (2015) which outlined policies in countries producing students who performed highly in international standardized tests concluded that 'high performing' countries have teacher education policies that are aligned and interconnected.

This paper is a literature review to check results of studies that deal with pre-service science education in the Philippines. It identifies practices and principles that can be used to inform the future development of science teacher education policies in the Philippines. The results show that student internship plays an important role in integrating theory and practice in teacher education. However, pre-service teachers encountered problems in constructing assessment tools in measuring science learnings. Research capability of Filipino pre-service teachers is important. However, there are limited research papers focusing on this. Other results are further discussed in the paper.

Keywords: *Pre-service science education, Teacher education policies, Science performance, Practices, Research skills*

INTRODUCTION

The hurdle to quality education continues to challenge science educators in the Philippines. The alarming result of PISA (Programme for International Students Assessment) 2018 perturbed the Philippines as it landed on the last spot. After the implementation of K-12 program, the Philippines finally joined for the first time in an international assessment of basic education (De Dios, 2019, December 3). PISA measures the ability of 15-year-old students in reading, mathematics, and science [Organization for Economic Co-operation and Development (OECD), (2018)]. There will be “aggressive reforms” through its “*Sulong Edukalidad*” will be implemented to address the issue and gaps in achieving quality education in four areas: “(1) *K to 12 review and updating*, (2) *Improvement of learning facilities*, (3) *Teachers and school heads’ upskilling and reskilling through a transformed professional development program*; and (4) *engagement of all stakeholders for support and collaboration*” as stated by the Department of

Education (DepEd) (2019, December 4). DepEd secretary Briones on the other hand, mentioned that the results of PISA can be credited to the lack of government support to the department's projects by means of its gross domestic product budget allocation (Moron-Ciriaco, 2019, December 6). However, going through the pertinent data and results of performances of the country in both national and international assessments, the result of PISA was never new, especially in the field of science and mathematics. For instance, the result of National Achievement Test (NAT) for grade 6 elementary pupils in 1996 showed a mean score in science test of 41.5% while in 2005 it gained a score of 54.1% from which 14.8% of these pupils only attained mastery levels of science curriculum goals. Likewise, a 39.5% mean score was achieved by 4th year high school students, which resulted to only 1.8% of these students attained mastery level of science curriculum goals (Bernardo, Limjap, Prudente, and Roleda, 2008). It also clearly indicates that the overall mean percentage score (MPS) of students in science in NAT since the start of its implementation almost fall below 50%. In addition, the results of TIMSS in 2003 also showed the poor performance in science from which Philippines ranked 43 out of 46 countries (Falmasco, 2014, May 28). The devastating results may be attributed to different factors which concern teacher education policies.

In the article of Moyle (2015) which critically analyzed factors behind the success of countries producing students who performed high in international achievement tests such as PISA, TIMSS, and PIRLS, it was found out that these countries have teacher education policies that are aligned and interconnected. As expected government investment in education is always on the list which already mentioned above by DepEd Secretary Briones as the key point why students have poor performance in national and international assessments. Setting aside this factor, Moyle (2015) checked other teacher education policies in these countries which significantly contributed in the outstanding performance of the students. These are *“creating identifiable career paths in teaching, attracting high-quality applicants, employing effective quality assurance policies and procedures, working in partnership with schools to train teachers, and using research and enquiry as ways to develop an informed, reflective, teaching profession”*.

Guided by the results, this study conducted a literature review in the pre-service science education in the Philippines as Moyle (2015) emphasized how teacher education policies in these

countries are being offered. However, upon checking pertinent literature, it revealed that there are a limited number of papers and sometimes none in the Philippines context to analyze. Thus, this study focused on literature about the identifiable career paths in teaching and research capability of pre-service science teachers which will possibly help in leading to better quality assurance policies and procedures in the Philippine science education. Studies done from 2016 to present conducted or focused in the Philippine setting are the articles being reviewed. The reviewed articles are retrieved using open access studies by Google Scholar. The results of the study can be used to inform the future development of science teacher education policies in the Philippines.

PRE-SERVICE SCIENCE EDUCATION IN THE PHILIPPINES

Using the theme, “*pre-service science education in the Philippines*” in the search engine of Google Scholar, it revealed 3 010 related studies with filter option of articles published from 2016 to 2019. The majority of studies focused on self-efficacy, readiness on K-12 curriculum, technology integration, student internship, pre-service teachers experiences and performances, and pedagogy-content-knowledge (PCK) of pre-service teachers. Having the following factors, this study merged and opted to deal with the following factors that answered the identifiable career paths in teaching and research capability for pre-service science teachers: a) curriculum and pedagogy readiness; b) pre-service teachers experiences and perceptions; and c) research capability. There were 16 studies reviewed which are related to this study.

Curriculum and Pedagogy Readiness

The implementation of K to 12 curriculum in 2012 has challenged both the basic education teachers and higher education institutions instructors as there were many changes in the content, pedagogy, sequence, and assessments in the different curricular area per grade level. Curriculum developers, principals, academic heads, and teachers in both public and private schools underwent series of orientation, trainings, and workshops during K to 12 implementation. Higher education institutions on the other hand changed it gear to keep abreast in the changes brought about by K to 12 curriculum implementation.

Meanwhile, in the results given by Google Scholar, quite a number of paper discussed about the readiness of Filipino pre-service teachers in the implementation of K to 12 curriculum including scientific skills, technology integration, and PCK in science curricular program. In a study of Tan and Rodriguez (2016), pre-service teachers asked to rate their perceived efficacy in the different areas in teaching the K to 12 curriculum. Among the different areas, developing higher order thinking skills and assessing and evaluating learners performance got the lowest overall ratings while the rest of the areas pre-service teachers have high overall ratings. Similarly, in a study conducted by Coronado (2019) showed that pre-service science teachers encountered problems when it comes to assessment of students' science learning during on-and-off campus experience. These can be attributed to the following problems: (a) the use of table of specification to construct question items, (b) parallelism of the objectives of the lesson to the assessment tool, (c) creating an effective distractor for the multiple-choice, and (d) time-constraint in test construction. Also, pre-service science teachers preferred traditional rather than authentic types of assessment tools.

On the other hand, a good predictor of how ready a pre-service teacher in K to 12 curriculum is by means of their content and knowledge ability. In a study conducted which involved BSEd major in Biology students from Leyte Normal University, got a 'satisfactory' level while pre-service elementary teachers performed 'low' to 'very low' levels in scientific skills using Test of Basic Scientific Literacy (TBSL) consisting of the following topics: *Nature of Science; Science Technology and Society; and Science Content Knowledge* (Flores, 2019). It is important to note that graduates of elementary education are expected to teach different subject areas involving science. The alarming result of the study may directly affect science education as a whole. In a study conducted by Ybañez, Sagayap, and Camacho (2016), it indicates that the scientific reasoning skills has positive correlation with Chemistry performance while high English language proficiency does not indicate a high competency in Chemistry content-knowledge.

Overall, undergraduate subjects of teacher education, such as measurement and evaluation must be revisited to help the pre-service teachers in the struggles of preparing for higher order thinking activities and construction of test items. Pre-service science teachers

should also know how to prepare quality authentic assessment tools. Likewise, scientific skills and literacy are very important to be ready with the K to 12 curriculum.

Pre-service Teachers Experiences and Perceptions to Teaching

Pre-service teachers are those who are not yet teachers but completing their teaching courses. The Australian Institute for Teaching and School Leadership (AITSL) (2014) identified the “broad success factors” for effective teacher education which involved a clear vision from pre-service teacher education to the entire program has clear vision, integration of theory and practices, highly skilled and well supported supervising teachers, and sustainable, scalable partnerships (in Moyle, 2015). In the Philippine policy, in order to integrate theory and practice, student internship (Field Study) is part of the teacher education curriculum which connects the gap between theory and practice. The results of the study confirmed that the student internship program is the best way for students to be trained and exposed to the real classroom setting to prepare and possibly become qualified teachers of our country (Tindowen, Bangi, and Parallag, 2019). Likewise, it revealed that student internship had positive and negative outlook for pre-service teachers which in turn recommended that cooperating or supervising teacher and field study instructor should work hand-in-hand to properly guide student teachers (Valdez and Magdara, 2018). Tindowen, et. al. (2019) also divulged that pre-service teachers faced challenges and issues with the kind of work during their internship. Though there were a limited number of literature conducted for Filipino pre-service teachers, it still clearly define the role of integrating theory and practice to teacher education policies. Similarly, the student internship program is said to be effective since it is responsive to the needs of the current industries as well as in guiding pre-service teachers to strengthen both hard and soft skills needed in their chosen profession (Tindowen, Bangi, and Parallag, 2019).

On the other hand, when 20 pre-service and 20 beginning teachers in the City of Manila were asked about their concept of competence of teaching revealed that pre-service teachers ‘saw’ and ‘understood’ teaching competence in four varied ways, these are: *“to possess desirable characteristics of a teacher, to possess professional readiness to teach, to manifest positive relationship with others, and to respond to environmental and social changes”* (Abulon and

Balagtas, 2016). The results of the study helped in the further development of the Philippines' National Teacher Competency-Based Standards (NCBTS), teacher education institutions' curricular programs, and admission policies (Abulon and Balagtas, 2016). The study also clearly exhibits how pre-service teachers view the attributes of a competent teacher and may serve as a guide on how to become a competent teacher when the right time comes.

Furthermore, in dealing with three major subject areas of teacher education in the Philippines, it was found out that general education courses are predictors of self-efficacy while professional and specialization subjects are negative predictors of self-efficacy among mathematics and science majors (Aure and Jugar, 2017). Moreover, the results of ANOVA and regression analyses showed that as the year level of pre-service mathematics and science teachers increases, there is a significant decrease in the self-efficacy of students. This may be attributed to the increasing number of specialization subjects which resulted to the increase in the level of difficulty thus, decreasing the self-efficacy of the pre-service teachers (Aure and Jugar, 2017). The results of experiences and perceptions to teaching will help in crafting the program and policies in teacher education. Interventions should be given to students who are having difficulty in their field of specialization. Similarly in the study conducted by Flores (2019), when students were asked to rate their science teaching self-efficacy, overall results show 'medium level' or the respondents are not too confident nor timid in their ability as a science teacher, but indicates that if students have a high level of scientific skills, they also have high level of science teaching self-efficacy.

Research Capability of Pre-Service Teachers

As stated, 'high performing' countries have research and enquiry as the essential part of teacher education programs (Moyle, 2015). Government role is significant in promoting science and technology culture in every individual to contribute to the growth and innovation of the country's economy (OECD, 2016). There are already efforts to improve our country's situation of research and development but still lacks support from the government and at the same time our country is still coined with weakness and scantness when it comes to science, technology, and innovation (STI) human capital as data indicated that we only have 270 researchers for every

one million population in 2013 which is below the UNESCO norm of 380 per million population [National Economic Development Authority (NEDA), (2017)]. The role of a science teacher is crucial in this venture and pre-service teachers must be equipped with the skills and abilities of a researcher especially, basic education students are asked to produce investigatory projects and researches. Unfortunately, there is only one paper that deals with the research capability of pre-service teachers in the Google Scholar portal. The results of the study show that participants have high level of anxiety, average level of self-efficacy, and positive attitude in conducting research (Natividad, Mangulabnan, and Canlas, 2019). Likewise, students who have high self-efficacy have high level of attitude towards research. Thus, it was recommended that continuous revision of programs and activities towards research must be done.

CONCLUSION

Results of the review of literature in this study indicates that there are limited paper that concerns pre-service science education in the Philippines which led to limited number of factors being discussed. Majority of the studies in the literature gathered are institutionalized while few are local/regional. Limited or no study focused on national level when it comes to pre-service science education and its different areas of concern though these studies give pertinent information about teacher education in the Philippines. To analyze the current situation of science teacher education policy, three major themes were used: a) curriculum and pedagogy readiness; b) pre-service teachers experiences and perceptions; and c) research capability. Based on the literature review, the following may give inputs to the future development of science teacher education policies in the Philippines:

- Scientific skills and scientific literacy among pre-service teachers are vital in the preparation of K to 12 curriculum;
- Test construction in the education courses should be revisited (development of HOTS questions and preparation of authentic type of tests);
- Strengthen the alliance of cooperating teacher and field study instructor especially, during problems encountered by pre-service teachers;

- More researches to measure the capability of Filipino pre-service teachers in terms of content, pedagogy, knowledge, and technology integration. Introduce also the concept of NCBS and PPST (Philippine Professional Standards for Teachers) for them to be aware of a measure of quality teacher;
- Improve self-efficacy among pre-service teachers;
- Revisit activities and the curricular program of research in teacher education. Conduct a study to measure the capability of pre-service teachers in research to identify strengths and weaknesses; and
- Ensure that all colleges and universities comply to the standards set in teacher education. As much as possible, accreditation should be required to all colleges and universities offering teacher education to ensure the quality of its graduates.

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