GENDER SENSITIVENESS OF SECONDARY SCIENCE TEACHERS' PEDAGOGICAL CONTENT KNOWLEDGE

ARLON P. CADIZ[1], ANTRIMAN V. ORLEANS, Ph.D.[2]
https://orcid.org/0000-0002-3894-21381
cadiz.ap@pnu.edu.ph[1], orleans.av@pnu.edu.ph[2]
Curriculum and Learning Management Division (CLMD)
Regional Office III (Central Luzon), Philippines[1]
College of Graduate Studies and Teacher Education Research (CGSTER)
Philippine Normal University, Philippines[2]

ABSTRACT

While academic institutions are gearing and propelling for 21st-century teaching and learning in science education to uplift the qualities of our science teachers in the aspects of the curriculum, pedagogy, and assessment, it can be also argued that oftentimes gender equality has been an issue in science classrooms. This is mainly because working with gender equality in science classrooms embraces a wide range of policies and practices. A cross-sectional survey design was used in this study to determine how secondary science teachers perceive differences between male and female students considering also their pedagogical content knowledge. The data analysis was built on descriptive statistics. The demographic profile of the secondary science teachers was noted. The analysis showed that science teachers perceived their pedagogical content knowledge as 'very high' in all five major areas. Among the given indicators, the majority of the science teachers perceived differences between male and female students in favor of the female students. The findings of this study would help science teachers to reflect on their teaching practices. Academic institutions should look into the way of enhancing the awareness among science teachers on promoting gender sensitivity inside the classroom. The schools with the support of education leaders need to intensify science teachers' abilities to handle gender differences while strengthening instructional strategies for gender equality education primarily in gender inclusion in the science curriculum as the primary direction of the results of this study.

Keywords: Gender Sensitiveness, Filipino Secondary Science Teachers, Pedagogical Content Knowledge (PCK), Science Teachers'

INTRODUCTION

Science teachers play a pivotal role in establishing students' interest in learning science. They engage students in different learning experiences to develop students' understanding of the nature and concept of science. By means of varied pedagogical approaches of teachers, students have the opportunity to be exposed to the real world of scientific exploration. New technological advances are also available for teachers to have easy access of those materials needed in the prescribed learning competencies.

Teachers are now more open to relevant changes in the educational system specifically in the delivery of instruction in science. Science teachers adapt to changes in the approach of making students learn better in terms of content in science. Through this, science teachers become more resourceful in planning, designing, and finding appropriate learning resources suitable for the needs and interests of the students. In other words, motivating students to learn is the reflection of the presence of teachers inside a science classroom. It has something to do with the level as to how students achieve the learning outcomes.

These teachers inspire the students to think critically and creatively. Science teachers' knowledge of content and the manner of how they deliver or implement the teaching process are their weapons to become effective in educating the students. There should have a constant self-assessment on what particular area teachers have difficulties in so that they can find ways how to address these difficulties. Education authorities can provide various programs for science teachers at the elementary level in conformity with the demands of maintaining and or somehow improving the quality of the teaching-learning process in the science area. Science teachers should update themselves on science teaching techniques and approaches which can be reflected in their individual professional development plans. Given the fact that they are the direct implementers of the curriculum, they show direction and guide the learners or students in the way that they should be. Mathew, Mathew, & Peechattu (2017) reiterated that teachers are the greatest assets of any education system. This is true because teachers are the nation-builders. Hence, up to modern times, it is still a global issue in terms of the best preparation for quality science teachers. A "good teacher" should possess a wide range of qualifications (Liakopoulou, 2011).

According to Kind (2009), one of these arguments is that science teachers need to 'know more science' in order to be 'better'. The knowledge of the content acquired by science teachers during their schooling and from different seminars and training is not a total guarantee that they are better and more effective until it manifests in their teaching practices. Science teachers may derive their PCK from their own teaching practice as well as from schooling activities in science wherein there is a great involvement of students (Jang & Chen, 2010). Science teachers should equip with the fundamental characteristics involving PCK to have full potential traits in their performance and being professionals. The qualities that can ensure a teacher's effectiveness are not the sum of his knowledge, but rather the link between the different types of knowledge he possesses (Liakopoulou, 2011). Lucenario, et al., (2016) argued that the teaching process which aims to contribute to the empowerment of teachers, the enhancement of the teaching status, and the improvement of the pedagogical content knowledge (PCK) of teachers should be intensified. Students get more interested when teachers deliver a suitable pedagogy for the learning of students in science. The learning interactions provided by science teachers and the quality of their teaching are directly linked to the interest of students in science (SEI-DOST & UP NISMED, 2011). Science teachers cannot deny the fact that society changes drastically. They are more challenged when it comes to imploring the teaching-learning process effectively inside their classrooms. The core qualities of an effective teacher are absolutely necessary due to teachers' absolute role in the classroom to make the maximum effect on students' learning (Sahin & Adiguzel, 2014). Science teachers believe that science education has to be continuously improved to become more responsive when it comes to the needs of society. They serve as role models not only for the students but also for the society they are living in (Liakopoulou, 2011). Teachers can make a better society (Ansari & Malik, 2013). The complexity of teaching requires teachers to question their practices for their own professional development in order to improve and to increase learner performance. Almost all the teachers agreed that boys and girls should receive equal treatment in science classrooms (Moletsane & Reddy, 2011). Given the fact that teachers should have the mastery of the content, be able to deliver the appropriate strategies, and know how to use accurate assessment tools in science, the classroom environment is difficult to handle due to the issues of gender bias and lack of gender equity. Hence, to address various issues on gender bias, the DepEd provides guidelines for Gender-Responsive basic education mandated DepEd schools to integrate the principles of gender equality, gender equity, gender sensitivity, non-discrimination, and human rights in the provision and governance of basic education. This is to promote inclusive education that ensures girls' and boys' equal access to learning opportunities, fair treatment in the learning process, and equitable outcomes. Moreover, teachers should be engaged in the promotion of gender equality in the curriculum, learning materials, teaching

methodologies, and support services that should not only aim at eliminating gender stereotypes but also transforming gender relations toward empowerment and social change (DepEd Order No. 32, s. 2017).

OBJECTIVES OF THE STUDY

This study aimed to determine the perceptions of science teachers on their pedagogical content knowledge and perceptions on differences between male and female students inside a science classroom. This study aspired to bridge the knowledge gap on the understanding of teachers in the aspect of gender differences relative to different aspects of the delivery of science curriculum.

METHODOLOGY

This study made use of the cross-sectional survey design. A cross-sectional survey design is commonly used by researchers to collect data at one point in time and it is advantageous in terms of measuring current attitudes, beliefs, opinions, or practices (Creswell, 2012). In this study, a cross-sectional survey design was used to determine the perceptions of secondary science teachers on the behavior of male and female students in a science classroom and their pedagogical content knowledge. The total number of respondents obtained using a simple random sampling was 120. The participation of science teachers was voluntary. They were fully informed that the data will be gathered from them will be treated with the utmost confidentiality.

This study used an adapted survey questionnaire on pedagogical content knowledge of science teachers and a self-structured survey questionnaire on perceptions of science teachers on gender differences. The Pedagogical Content Knowledge (PCK) Survey Questionnaire is composed of 5 major areas (orientation towards science teaching, knowledge about science curriculum, instruction strategies, students' learning, and assessment of students' learning). The instrument follows a 4-point Likert scale. The adopted survey questionnaire has Cronbach's alpha value of 0.92 for internal consistency. The self-developed survey questionnaire about teachers' perceptions on differences between male and female students in a science classroom was evaluated by experts. The researcher secured informed consent from the respondents of the online survey. The spreadsheet from the online survey using Google Forms was monitored for about 2 weeks to achieve the target number of respondents. The data were analyzed and statistically interpreted using descriptive statistics in analyzing the perceptions of science teachers on differences of male and female students in a science classroom and their perceptions on their pedagogical content knowledge. Moreover, self-developed questionnaire obtained a Cronbach's alpha value of 0.89 for internal consistency.

RESULTS AND DISCUSSION

1. Pedagogical Content Knowledge of Secondary Science Teachers

The respondents generally labeled their pedagogical content knowledge as *'very high'*. The result implies that science teachers have developed already the expectations relative to teaching and learning outcomes. In the area of orientation in science teaching, science teachers are much more aware of their capability to teach the subject because they are aware of the given indicators. They are updated with the new trends and innovations in science education because they use to participate in seminars and trainings sponsored by the Department of Education or organized by private institution providers. These teachers are also aware that their students have different learning styles, potentials, and skills which make them unique from each other. They also let their students explore and engage in lessons as if the students are in a real-life scenario of an environment. Teachers use to integrate simulations in this situation which requires the students to think critically and creatively. Science teachers engage students in different learning experiences; deal with the needs and issues of the learners and demand time if they reflect on their daily teaching-learning activities, and motivate

students to learn is the reflection of the presence of teachers inside a classroom (Cadiz, 2021). Furthermore, they are aware of the importance of aligning any type of assessment in the objectives of the lesson. This is to make students ready to equip the expected learning outcomes of the 21st century. Moreover, teachers are also aware that they should do this for the students to be much more prepared to cope with the changes and adapt to the demands of society. In this regard, teachers are also aware that the needs and interests of the students should be connected to the laws and theories in science by organizing concepts in accordance with the categories prescribed in science disciplines. Keller, Neumann, & Fischer (2017) reiterated that subject matter knowledge to teachers' understanding is an important factor of how to teach contents to students. Subject-matter knowledge if put into practice may enable a different way of approaching what is seen as "learning science," and at the same time, how science knowledge is generated. It is therefore important for the teacher to be aware of the possible difficulties that may arise when using school science models (Acher, Arca, & Sanmarti, 2007).

In the area of knowledge about science curriculum, they know the direction of their lessons by having the appropriate science curriculum to be implemented in the classroom. Secondary science teachers can prepare lesson plans/lesson logs which include important complete parts and follow the budget of work intended for their lessons. Another indicator that the teachers are also knowledgeable about science curriculum is that they know how to select appropriate learning materials or resources suitable for the pupils. They make sure that as they select the learning resources anchored on the prepared lesson plans/logs, they can able to apply constructivism principles and other theoretical philosophies in learning delivery. They should know how to apply these principles to adhere with the expected outcomes of the 21st century skills necessary for the students to achieve. Another indicator that supports their knowledge about science curriculum, following the desired learning competencies, they know how to set the objectives/targets intended for the lessons.

These things were reflected to their prepared lesson plans/logs. Moreover, in relation to the learning resources, they have the knowledge to use different electronic sites to have access on these materials. The results drawn from the present study contradict the findings revealed by Lee and Akerson (2010) that teachers drew little upon their knowledge of curricula specifically for Nature of Science. They provided a reason that there is a lack of availability of specific curricular materials and programs to address the nature of science, versus deficiency in teachers' knowledge of such materials. The teachers are very much aware of the use of online and electronic materials since these learning resources are available online for easy access at this time. In terms of the knowledge about instruction strategies, secondary science teachers can deliver their lessons by applying efficient and various teaching techniques in teaching the topic. For them to be able to do this, they use to integrate multi-representative materials, models, and realia in teaching the concepts. This has something to do with their orientation about science teaching that they should make the lessons fun and interactive for the students. It can also be observed in the data that teachers much give importance in presenting the topic in a well-modulated voice. They make sure also that as part of their teaching approaches; they use examples and situations anchored on real-life situations. Modification of the instruction based on the learning needs and interests of the students is also the concern of the teachers.

This result conforms to the data revealed by Lee and Akerson (2010) that teachers were able to implement these strategies as modeled for them but also improvise and develop their own unique strategies for embedding the nature of science into their teaching. Integration of the appropriate learning resources according to the teachers is an important tool for the delivery of their lessons. The integration of multimedia and other educational technology materials is also observed and usually done by the teachers. Furthermore, another indicator of strategies that the teachers employed in their science lessons is the integration of games in their lessons. Soobik (2014) reiterated based on the findings of the study that teaching would greatly benefit from the introduction of more activating

teaching methods, especially those which are connected with applying technology: web-based materials, using mobile applications etc. The researcher further added that teachers continually consider the practical activity and supervising the work process as important parts of technology education lessons.

Activities prepared with differentiated instruction are also used by science teachers as part of their instructional strategies. In relation to these teaching practices, teachers need to use a wider range of instructional strategies and techniques to impart the concepts to students (OECD, 2009). The orientation of science teachers with respect to the learning styles, needs and interests of the pupils supports this data. In the aspect of knowledge about students' learning, secondary science teachers employ higher-order thinking questions in their lessons to make the students think critically. They also encourage pupils to participate in the activities that they implemented. This data has something to do with the integration of different instruction strategies with respect to activities such as games, differentiated instruction, and simulations as well. Teachers engage pupils to apply concepts in real-life situations through these activities. This supports the indicator stated earlier that the teachers are aware of the importance of applying real-life situations of concepts in their lessons as part of their orientation in science teaching as well as to their instruction strategies with respect to the use of different activities in science. They also provide feedback right after students' answers to facilitate the discussion in order to achieve a common understanding of the concepts.

Akalin & Sucuoglu (2015) reiterated based on the findings of their study that it is critical to note that with the use of intervention based on giving short-term information and Performance Feedback on preventive strategies for facilitating effective instruction; teachers can use the newly learned strategies in their classrooms. As a strategy to encourage the students to participate, teachers use reinforces like awards and pointing system to motivate them. Moreover, science teachers believe that inquiry-based activities in which students must engage are important tool for students to learn the necessary learning competencies in the 21st century.

Castro & Morales (2017) reiterated that learning science in the new curriculum is not limited to applying inquiry learning for students to attain student achievement and inculcate scientific literacy. It also highlights using the best possible method of inquiry (guided inquiry learning [GIL]) appropriate to the needs of the learner and learner's developmental maturity to motivate the students to engage in science and encounter success and difficulties as well. The aforementioned results in the present study contradict with the result of the study conducted by Lee and Akerson (2010) that in terms of knowledge of learners, it was noticeably absent from the data are discussions of difficulties teachers faced in helping students understand particular ideas about nature of science or misconceptions about nature of science they encountered in their classrooms. There is a need for a deeper understanding of the misconceptions and difficulties of students encountered inside the science classroom. Kyriacou (2012) also argued that teacher plays a key role in making sure that all the learning activities operate as smoothly as possible and are effective in fostering the intended learning outcomes.

As to the knowledge about assessment of students' learning, science teachers provide appropriate assessment in various types of activities they've facilitated. There's a standard criterion in grading the students that the teachers are following. The teachers are very much particular that assessment should promote fairness in grading. Assessment also used by teachers as basis of some modifications of their lessons in science. The result of the test serves as feedback for the teachers in revising the delivery of their instructions. They ensure that the assessment prepared is appropriate and suitable for the students. These results have something to do with the components of the grading system set in accordance to the prescribed DepEd grading system. It is also observed among teachers that desired learning outcomes are the basis of constructing assessment for the students and in particular, they prepared table of specifications for their assessments.

Finally, as to the performance-based outputs, teachers prepare rubrics to assess students' outputs. Goodnough & Hung (2009) reiterated that in the area of knowledge of assessment, the teachers use diverse assessment approaches to assess students' learning which including rubrics reflecting the need to examine many types of student learning such as understanding scientific concepts and developing problem-solving skills to give learners opportunities to demonstrate, in different ways, what they were learning. Science teachers are aware of the use of assessments for students' learning.

2. Secondary Science Teachers' Perceptions on Differences of Male and Female Students

Results revealed that more than half of the secondary science teachers perceived differences between males and females in the classroom. Secondary science teachers perceived the female students have intensive and systematic work in their science outputs, ensure that the outputs submitted are of quality, and with high self-confidence. The result of the present study in relation to the behavior of female students on their outputs coincides with the findings of Åhslund & Boström (2018) that they were more likely to manage the set requirements of the curriculum.

This implies that female students make sure that they can comply with and submit important requirements. In this manner, science teachers perceived the female students with high motivation and independence which drive them in doing the outputs. Moreover, science teachers also perceived that these female students possess leadership roles in science activities, are able to finish work on time and never submit late outputs, compete to finish the output first, create a favorable classroom climate. These behaviors of female students caught the attention of science teachers those female students gave importance to their outputs. Hence, female students were likely to be praised more by science teachers for the outward appearance of their work (Jung & Chung, 2006). This implies that science teachers perceived the female students who ensure that their outputs are neat and they also obey the teacher's directions. Female students consistently have high scores in quizzes, long tests, or periodical tests as perceived by secondary science teachers.

On the other hand, science teachers perceived that both male and female students do little or no school work in science class. Male students are uncertain if their work is good enough based on the perception of science teachers yet science teachers perceived them as hardworking and organized when it comes to their work. However, science teachers perceived male students who have less interest in science, less positive discipline, and ill-prepared & childish too. This is the reason why science teachers should impose discipline more on male students. This is supported by the study conducted by Jung & Chung (2006) that male students received more disciplinary contact from teachers than did female students. The researchers added that male students drew the attention of teachers because male students misbehave conspicuously. This implies that male students were more likely to be disciplined than female students, even when the female students were doing the same misbehavior. It seems that the science teachers perceived that male student have low performance towards science subject

CONCLUSION

The study underscores the findings which serve as supplemental information with regard to the pedagogical content knowledge of teachers and their perceptions on gender differences. This study aimed to describe how secondary science teachers perceived differences between male and female students in science classrooms and their pedagogical content knowledge. Results showed in this study that all teachers labeled their pedagogical content knowledge as 'very high' which implies that they have already attained the expected practices in the science classroom supported by the given indicators. However, it should also be noted that secondary science teachers perceived differently as to the manner of which male and female students behave in the class. Among the given indicators, the majority of the science teachers perceived differences between male and female students in favor of the

female students. Some of the indicators in favor of the female students have intensive and systematic work in their science outputs, ensure that the outputs submitted are of quality, with high self-confidence, possess leadership roles on science activities, able to finish work on time, and never submit late outputs, compete to finish the output first, and create a favorable classroom climate.

Furthermore, female students consistently have high scores in quizzes, long tests, or periodical tests. On the other hand, science teachers perceived positive and negative behaviors for male students. Male students are uncertain if their work is good enough, hardworking, and organized when it comes to their work but they have less interest in science and less positive discipline and ill-prepared and childish. As implications of this study, educational institutions should have plans to have thorough discussions on the potential of gender inclusion to promote and improve pedagogical approaches while establishing gender equity. School leaders and teachers should think strategically to be more open about the importance of gender equality particularly in science classes focusing on the manner of what they teach, how they teach, and how they role model their attributes and practices to somehow address gender biases in the classroom. Through this, K-12 science classrooms would be able to provide a context for creating development in the gender equality of science instruction.

RECOMMENDATION

In order to establish and sustain gender equity in K to 12 science classrooms, the following would be done by education authorities: (1) there should be the development of a training program for enhancing science teachers' abilities and be aware towards implementation of gender equality education; (2) nurture teachers' potential to develop materials integrated with instructional strategies for gender equality education; and (3) analyze different instructional behaviors of teachers as to how they interact with their students, how they should select appropriate learning materials for students which can be done by means of classroom observation. Further studies may be done to show thorough investigation towards strengthening the desire of achieving the goal of sustainable practices in order to build inclusive environments for all students.

REFERENCES

Acher, A., Arca, M., & Sanmarti, N. (2007). Modeling as a teaching-learning process for understanding materials: A case study in primary education. *Wiley InterScience (www.interscience.wiley.com)*.

Akalin, S., & Sucuoglu, B. (2015). Effects of classroom management intervention based on teacher training and performance feedback on outcomes of teacher-student dyads in inclusive classrooms. *Educational Sciences: Theory & Practice, 15*(3), 739-758.

Ansari, U., & Malik, S. K. (2013, November). Image of a teacher in a 21st century classroom. *Journal of Educational and Instructional Studies in the World, Volume 3*(Issue 4).

Åhslund, I. & Boström, L. (2018). Teachers' perceptions of gender differences -What about boys and girls in the classroom? *International Journal of Learning, Teaching and Educational Research Vol. 17 No. 4, pp. 28-44, https://doi.org/10.26803/ijlter.17.4.2.*

Cadiz, A.P. (2021). Pre-service teachers' reflective practice and their teaching practicum beliefs. *Jurnal Inovatif Ilmu Pendidikan*, 3(2), pp. 105-119.

Castro, J.A. & Morales, M.P. (2017) "Yin" in a guided inquiry biology classroom – Exploring student challenges and difficulties. *Journal of Turkish Science Education*. 14(4).

Carlone, HB. (2004). The cultural production of science in reform-based physics: Girls' access, participation, and resistance. J Res Sci Teach. 41(4):392±414.

Chilisa, B. (2000). Towards equity in assessment: crafting a gender-fair assessment. Assessment in Education. 7(1):61±81. https://www.tandfonline.com/doi/abs/10.1080/713613318

Creswell, J.W. (2012). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research 4th edition*, Pearson Education, Inc., 501 Boylston Street, Boston, MA 02116.

DepEd (2017). *Gender-responsive basic education policy*. DepEd Order #32, s. 2017. June 29, 2017. Department of Education, Philippines. http://www.deped.gov.ph/wp-content/uploads/2017/06/DO_s2017_032.pdf

Goodnough, K. & Hung, W. (2009) Enhancing pedagogical content knowledge in elementary science, *Teaching Education*, 20:3, 229-242, DOI:10.1080/10476210802578921

Halpern, D., Aronson, J., Reimer, N., Simpkins, S., Star, J., and Wentzel, K. (2007). *Encouraging girls in math and science: IES practice guide.* http:ies.ed.gov/ncee/wwc/pdf/practiceguides/20072003.pdf

Hutchinson J, Stagg P, Bentley K. (2009). STEM career awareness timelines: Attitudes and ambitions towards science, technology, engineering, and maths (STEM at Key Stage 3). International Centre for Guidance Studies. http://derby.openrepository.com/derby/bitstream/10545/243597/1/ Career_related_learning+and_science_education.pdf.

Ikerbyt, P., Ward, P. & Li, W. (2015). Effects of improved content knowledge on pedagogical content knowledge and student performance in physical education. *Physical Education and Sport Pedagogy, Routledge Taylor and Francis Group* http://dx.doi.org/10.1080/17408989.2015.1095868

Jang, S.-J., & Chen, K.-C. (2010). From PCK to TPACK: developing a transformative model for pre-service science teachers. *J Sci Educ Technol, 19*, 553–564.

JidesjoÈ, A. (2008). Different content orientations in science and technology among primary and secondary boys and girls in Sweden: Implications for the transition from primary to secondary school? NorDiNa. 4(2):192±208.

Jung, K. & Chung, H. (2005). Gender equality in classroom instruction: introducing gender training for teachers in the Republic of Korea, Asia and Pacific Regional Bureau for Education, UNESCO, Bangkok.

Keller, M. M., Neumann, K., & Fischer, H. E. (2017). The impact of physicsteachers' pedagogical content knowledge and motivation on students' achievement and interest. *Journal Of Research In Science Teaching, 54*(5), 586–614.

Kind, V. (2009): Pedagogical content knowledge in science education: perspectives and potential for progress, *Studies in Science Education*, 45:2, 169-204

Kyriacou, C. (2012). Teaching. In J. Arthur & A. Peterson (Eds.), *The Routledge companion to education* (pp. 107ñ114). New York: Routledge.

Lange, K., Kleickmann , T., & Möller, K. (2012). Elementary teachers' pedagogical content knowledge and student achievement in science education. *Ninth ESERA Conference 2011.* In C. Bruguiere, A. Tiberghien, & P. Clement (Eds.), Science Learning and Citizenship.

Liakopoulou, M. (2011, December). The Professional competence of teachers: Which qualities, attitudes, skills and knowledge contribute to teacher's effectiveness. *International Journal of Humanities and Social Science, 1*(21)

Lucenario, J.L.S., Yangco, R.T., Punzalan, A.E., & Espinosa, A.E. (2016). Pedagogical Content Knowledge-Guided Lesson Study: Effects on Teacher Competence and Students' Achievement in Chemistry. *Education Research International, vol. 2016*, Article ID 6068930: https://doi.org/10.1155/2016/6068930

Mathew, P., Mathew, P., & Peechattu, P. J. (2017). Reflective practices: A means to teacher development. *Asia Pacific Journal of Contemporary Education and Communication Technology (APJCECT), 3*(1), 126-131.

Moletsane, R. & Reddy, V. (2011). Gender equality in the mathematics and science school curriculum, *Human Sciences Research Council* www.hsrc.ac.za.

OECD (2009). Creating effective teaching and learning environments. First Results from TALIS – ISBN 978-92-64-05605-3

Sahin, A., & Adiguzel, T. (2014). Effective teachers qualities from international teachers' perspectives. *Research Gate*.

SEI-DOST & UP NISMED, (2011). Framework for Philippine science teacher education. Manila: SEI-DOST & UP NISMED.

Sjoberg S, Schreiner C. The ROSE project: An overview and key findings [Internet]. Oslo: University of Oslo; 2010. http://www.cemf.ca/%5C/PDFs/SjobergSchreinerOverview2010.pdf.

Soobik, M. (2014). Teaching Methods influencing the sustainability of the teaching process in technology education in general education schools. *journal of Teacher Education for Sustainability, vol. 16, no. 1, pp. 89 – 101,* DOI: 10.2478/jtes-2014-0005.

AUTHORS' PROFILE

Arlon P. Cadiz is the Regional Science Education Program Supervisor, Curriculum and Learning Management Division (CLMD), Regional Office III. He finished his MA degree at Philippine Normal University and working on his dissertation writing leading to the degree in PhD in Science education in the same university.

Dr. Antriman V. Orleans is a full professor of science education at the Philippine Normal University, Manila. He finished his doctorate degree in Hiroshima University, Japan and has published several research articles in science education.

COPYRIGHTS