Tracing Issues and Concerns on Technological Pedagogical Content Knowledge (TPCK) in Math and Science

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***Abstract* —** In lieu to the final examination of the Ph.D. students of the University of the Philippines Open University (UPOU) under EDSC 305 Seminar: Issues and Trends in Science, Mathematics, and Technology Education course thereby required to outline a concept note served as prerequisite mainly to address current issues in science, mathematics, and technology education. Thus, it also expected that the concept note presented should be novelty, thorough, analytical, and evidence based. Wherein, it showcases the rational of the specified program, possible policy implications and will be organized based to the following structure: Cover Page; the Proponents; the Potential Key Partners; Rationale; Program/Research Overview; and References. This paper explores the concept of self-evaluation in education to uncover concerns, issues and difficulties, which mainly, that enabling individual schools and teachers to self-evaluate effectively their tasks as a complex task that will require help and support from the community of professional evaluators as cited by McNamara & O'Hara, 2008.

***Keywords*—** Concept Note; Philosophy of Education; Science and Math Issues; TPCK.

I. INTRODUCTION

This article adheres to accept the challenged that raised by the Faculty in charge (FIC) of the course EDSC 305 Seminar: Issues and Trends in Science and Mathematics, and Technology Education answering those issues and concerns relative to teacher education particularly in mentoring and supervision. Using content review analysis (Kondracki, Wellman & Amundson, 2002), it was then understood that the effective teaching is not solely the responsibility of teachers, but instructional leaders like school heads and supervisors plays equally important roles in ensuring pedagogy of science and mathematics. As it was also emphasized that supervising science and mathematics instruction entails, among others, communicating high expectations for teachers, monitoring assessment, tracking, progress of students, coordinating curricular work, and supporting and mentoring teachers. Thus, certainties thru studies hereby employs to attain or acquire data that supplement to:

1. explain the roles of instructional leaders;
2. define quality supervision;
3. identify key issue in supervising science and mathematics teaching; and
4. differentiate supervision from mentoring.

Provided Dr. Monalisa T. Sasing, the FIC of the EDSC 305 course has directed his students in the University of the Philippines, Open University (UPOU) who took Philosophy in Education to draw a concept note (see appendix 1). Thus, basically students who took ESDC 305 course during the Second Semester, AY 2020-2021, of the UPOU were advised to read issues on teacher mentoring and supervision, and quality of supervision which mainly relative to science and mathematics.

Theoretical and Conceptual Framework

Eby, Rhodes & Allen (2007) integrated values on understanding and improving how schools provide instruction, thus they cited McPartland (1985) on his article titled "The Myth of the Mentor" emphasizing that mentor should have acted as a coach, extending teaching, feedback, strategies in preparing his trainees to be more confident and certain for such exposure or visibility. Looking onward to this progressive objective, and it is more advantageous if McNamara & O'Hara, (2008) concept on the self-evaluation of the educational policy should be adhere in order to evaluate the regulation of public services, and the servants in education. And also to extend evaluation and inspection of the import elements, issues and trends in science, mathematics, and technology education. Further, in order to draw a conclusive concept and to acquire precise, evidence based results Punya Mishra and Matthew J. Koehler's 2006 TPACK framework (see Figure 1) and the Persuasion Map Template (see Figure.

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2) cited from 19 Types of Graphic Organizers for Effective Teaching and Learning (n.d.).

II. METHODOLOGY

This study employing Explanatory sequential mixed method design (Subedi, 2016) in order to explore reality based on the actual scenario or perspective of the target beneficiaries/respondents that would redound to acquired data which contemplates to: explain the roles of instructional leaders; define quality supervision; identify key issue in supervising science and mathematics teaching; and differentiate supervision from mentoring. With this purpose, it is obviously supported a concept note that would serve as an instrument or materials to gather data, see on Appendix 1. And Using content review analysis (Kondracki, Wellman & Amundson, 2002) as the authors' basis in arriving conclusion.

III. RESULTS AND DISCUSSION

Eventually, a concept note was drawn to comply the challenged of Dr. Monalisa T. Sassing, the Faculty In-charge of the EDSC 305 course of the University of the Philippines as illustrated below in detailed was the actual results as to evidence based concept, as prescribed this concept note was done within the specified number of pages, double-spaces with arial style and with a font size of 12, properly imposed a plagiarism checked (see in Appendix. 1).

Precisely, the concept note was made evidently based on the following structured: the Cover Page that contains the title of the concept note, the names of the group members, and the submission's date which are aligned at the center; the Proponents, wherein it describes the profile of group members; the Potential Key Partners, this section lists the potential partner agencies and described their profiles; the Rationale, it briefly provide gaps/issues being address and discussed the main points based on the related literature, it also presents the significance of such program or research work; the Program/Research Overview, showcase the objectives, expected outcomes and outputs which were related to the objectives, described the program/research, determined the major activities, and identified the key target beneficiaries including their characteristics/demographics and rationale; and then, listed all the References with the application of APA style (7th edition).

Appendix 1. CONCEPT NOTE

The Cover Page

Tracing issues and concerns on Technological Pedagogical Content Knowledge (TPCK) in Math and Science

Edilmar P. Masuhay1, Marinel Diquino2

30th April 2021

The Proponents

EDILMAR P. MASUHAY

Author Biography

Edilmar Patagan Masuhay, was born in Mainit, Surigao del Norte, Philippines on August 31, 1972. Presently studied Philosophy of Education (Ph.D.) major Mathematics Education at University of the Philippine, Open University (UPOU), Los Baños, Laguna under SIKAP Grant Scholarship Program. Completed MS Mathematics Education under the CHED Kto12 Scholarship Grant, and Chosen as one of the CHED Success Story. From December 1997 to the present he is at service teaching math subjects in Surigao State College of Technology. He published his Thesis titled "Uncovering Transformative Experiences among Students with Shortcomings in Statistics" in the International Journal of Current Research (IJCR). Authored of five (5) unpublished books utilized by BAT and BSAF students of SSCT, the books titled are: Pre-calculus: a logic and geometric means; Mathematics in the Modern Word (Module Design); The historic and political system of the Philippines; The memoirs of Dr. Jose Rizal and his impact to the life of Filipinos, RA 1425; and The Philippine Government, Principles and Policies. Edited and published more than 30 research articles both sole and co-authored. Awardee as Journal Reviewer in International Journal of Advanced and Applied Sciences (IJAAS), an Institute for Scientific Information (ISI) Indexed. Published five (5) students' co-authored manuscripts as part of their Knowledge Skills and Attitudes (KSA) earned from their subject Mathematics in the Modern World (MMW) on their First Year, First Semester, CY 2019-20. Edited and assisted publication of more than ten (10) scholarly non-authored articles. Received GOOGLE SCHOLAR CITATIONS: Cited by three (5) Researchers from Qatar, Bangladesh, Singapore and Philippines on his article titled "Adversities on Covid-19 Set Forth an Argument Onward to Educational Endeavor Resulting to Develop a Modular Concept in the Learning Process". He was an affiliated member of the following professional researchers' organizations: NRCP; NOPTI; PNEE; PACSA; PARSSU; PASCHR; PARESSU; ERAAR and CARAGA LIBRARIANS AND LIBRARIES ASSOCIATION (CLLA), Inc.; and elected Faculty President of the SSCT-Mainit

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Campus. Moreover, he previously experienced to work as: Ex-Officio Member; Salesman; SGV Internal Auditor; Liturgical Ministry Member (Roman Catholic); Loan and Credit Investigator Officer under AUSAID Program; Vice-Dean to Administration and College Overseer; Assessor and Trainer in Training Methodology and Assessment; and Program Manager and Services Coordinator; Security Officer In-charge; ROTC Coordinator; and Business Affairs Office Secretary; Supreme Students' Council Adviser; Librarian Designate; and Faculty President-SSCT Mainit Campus.

MARINEL E. DIOQUINO

Author Biography

Marinel Elquiero Dioquino, from the place of beauty, serene yet powerful this is the home province of Sorsogon, born on April 23, 1988. Presently studied Philosophy of Education (Ph.D.) major Biology at University of the Philippine, Open University (UPOU), Los Baños, Laguna. She was a graduate a Bachelor of Science in Nursing, and after a year took up a methods of teaching in Sorsogon State University. Luckily by hard work, determination and optimistic she passed both the licensure examination for Nursing and Teacher. She also graduated her Master's degree on Science, major in Science Education in the same School. She is 9 years in teaching field but newly hired in government schools. Her first year in teaching was on Aemilianum College Inc. where she teaches science. After a year she transferred in an all school boys the Our Lady of Peñafrancia Seminary where for 8 years she teaches science from junior and senior high school. Currently, she is a public secondary teacher in Sawanga National High School and a writer for Learners Activity Sheet for SHS for the upcoming school year 2021-2022. She is still learning and determined to learn.

ANNIE RICHIL M. CAGAS

Author Biography

Annie Richil M. Cagas is a Secondary School Teacher II of Bacuag National Agro-Industrial School, Bacuag, Surigao del Norte. Graduated her college degree in Bachelor of Science in Agricultural Education major in Animal Husbandry at Surigao del Norte College of Agriculture and Technology. Fortunately, she was able to avail the Certificate Program Teaching in Mathematics, a scholarship program of Department of Science and Technology for non-major teachers teaching Science and Mathematics way back 2006-2007.Presently, she is enrolled in Master of Arts in Educational Management at University of Southern Philippines Foundation at Cebu City.

MARIDEL M. MAHOMOC

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Maridel Masuhay Mahomoc is a Senior High School Teacher II of Bacuag National Agro-Industrial School, Bacuag, Surigao del Norte. She graduated her college degree as Bachelor of Science in Agricultural Education major in Animal Husbandry at Surigao del Norte College of Agriculture & Technology. Presently, she is enrolled at Surigao State College of Technology in her master's degree as Master in Industrial Education major in Industrial Arts. Currently, she is one of the SLM writer of Surigao del Norte division for the TVL-AFA (Swine) NC II, TVE-AFA (Ruminant), and ESP 9.

SUGAR O. MASUHAY

Author Biography

Sugar Olitres Masuhay is an Elementery School Teacher III of San Francisco Elementary School, San Francisco, Mainit, Surigao del Norte. Graduated her college degree in Bachelor of Elementary Education major in Science and Health at Saint Paul University Surigao, Surigao City. She took up her Master's Degree (MAED) at Agusan Colleges Inc., Butuan City earning 36 units with CAR way back 2018.

The Potential Key Partners

The proponents' delivering institution should be considered directly as a potential partner. The Delivering Higher Education Institution (DHEI) e.g. CHED, DepEd, and TESDA, shall:

1. Implement the work plan as stated in the project proposal;
2. Coordinate with the various stakeholders in implementing the activities/procedures stated in the proposal; and

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3. Spearhead the management of the project, particularly the early stage of implementation;
4. Monitor the day-to-day implementation of the project;
5. Do presentation and keeping records such inventory and sales; and
6. Publish project data and accomplishment.

Constituents: [(Public or Private); (Organization or Individual); (Professional or Non-professional)]

1. Admit or enroll to be part and beneficiaries of the program.

The Rationale

As prerequisite for Ph.D. Students of UPOU under the Supervision of Dr. Monalisa T. Sasing, FIC in EDSC 305 course. This Concept Note has been put into reality, and eventually this intention allows the proponents to read previous literatures about the Critical role of supervision and the Quality of supervision more probably related to Supervision of Science and Mathematics.

The reading activities serves as bases to answers the following questions:

1. What are key issues in instructional supervision?
2. What are other issues in instructional supervision?
3. What are the possible ways to address those issues?

Philippine Education: issues & concerns in school administration & supervision is a replica strata of the system, this thought has been shared in the discussion forum on issues in supervision. Evidently, based on literature other issues in Instructional Supervision were raised as enumerated under Trends, issues & concerns in school administration & supervision (n.d.), and among those issues, two issues have been emphasized by Ocampo, Lucasan & University of the Philippines (Eds.) (2019); and by Mehta (2004) as it was explained by them. Wherein, solutions were proposed to address those issues, and they provide a sufficient explanation as to how the proposed solutions can address the issues that were cited.

Among those issues and concerns in School Administration & Supervision, due to the prevailing tendency or inclination Trend expansion of educational opportunities and service Trends in school administration & supervision, findings showcase the following datas:

DepEd Budget

The government assistance to Students and Teachers in Private Education Act (GASTPE) as amended by Republic Act (RA) N0. 8545 (19998), has provided for the implementation of mechanisms that contribute to making quality education accessible to all Filipinos. GASTPE eventually extended assistance to Students and Teachers in privates' education, educational service contracting (ESC) program, teachers' salary subsidy (TSS), and Senior High School Voucher Program (SHS VP) thus, the private education assistance committee co-implements with the DepEd.

And while private schools claim their share for this intentions to cover the cost for quality education findings based on data were found not sufficient thus, the cost or value is less than what we're expected to defray the exactness of the vouchers vales. These scenarios are only among the real scenarios that the country was facing, with many challenges in implementing a national scale education programs such as ESC, TSS, and SHS VP, there are many opportunities for research in order to inform policies, to refine or modify process and practices, and to improve the effectiveness of the programs, which will contribute to realizing the broad goals of education in our country.
Enrolment and the number of teachers.

The expansion of educational services, turns such expansion as the enrolment in all levels increases, such that the educational services were also increasing in parallel in terms of money, materials, and manpower. And with the increase in the educational services, we may expect that the best of our administrators and supervisors will be put to a severe test. These issues of enrolment and no. of teachers can be possibly addressed easily once projection of population, enrolment and teachers were analyzed (Mehta, 2004).

Moreover, this course also permits the students to learn relative topics on mentoring teachers such that students were preferred to look or search a credible article about mentoring teachers, and for them to share their thoughts and ideas in forum on how mentoring differentiated from supervision.

The Program/Research Overview

Objective

This project aims to contemplate the Teacher Education Concern and Issues such that it is expected that students in this course should explain the roles of instructional leaders, define quality supervision, identify key issues in supervising science and mathematics teaching, and differentiated supervision from mentoring. Mainly, it is

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expected that teacher uncover their understanding on technology pedagogical content knowledge, differentiated pedagogical content knowledge from content knowledge, and assessed science/mathematics knowledge for teaching.

Implementing Strategies:

A. Entry protocol

A letter of permission will be sent to the local officials for the field sampling activities in the identified sampling sites.

B. Site visitation

A short program attended by the barangay officials and the extension's team tackle issues on the project titled.

Expected Output:

This concept note helps addresses questions on how teachers' mentoring improves their students' desires in learning math and science, on how teachers integrate their technological skills and pedagogical content knowledge in teaching, and bridging the gap of both teachers and students on their understanding in teaching science and mathematics.

Physically, this intension resulted to:

1. Documented minute excerpts from the said program; and
2. Formulated Treaties or Agreement between parties involved:
    - Enumerated chosen extension program for the chosen beneficiaries
    - Determined target beneficiaries
    - Come up an agreement for the said chosen program
    - Set schedules for extension/seminar workshop

Description of the program/research

This program or study is a phenomenal descriptive research [(Aanstoos,1983); (Horgan & Kriegel, 2007); (Balog, 2009); (Kriegel, 2013); (Feest, 2014)] that traces issues and concerns on TPCK in math and science based on published articles, literatures, observations, and teachers' and students' true to life experiences in math and science learning-process. Merely the main objective of this research is to discover teachers and student's insights, ideas, and problems during their math and science teaching-learning process.

Major Activities

This project aims not just at making changes in the workplace probably in teaching, but also make changes in the everyday life of the norms of teachers and students in the learning process and to their school. The set of proposed activities includes to adopt Shulman's theory on technology pedagogical content knowledge and emphasized that a teacher should at least know what to teach and how to teach, and should learn his/her student's difficulties and limitations. Thus, every teacher should learn the significance of Technological Pedagogical Content Knowledge, as illustrated below in figure 1. Punya Mishra and Matthew J. Koehler's 2006 TPACK framework, an instructional design model.

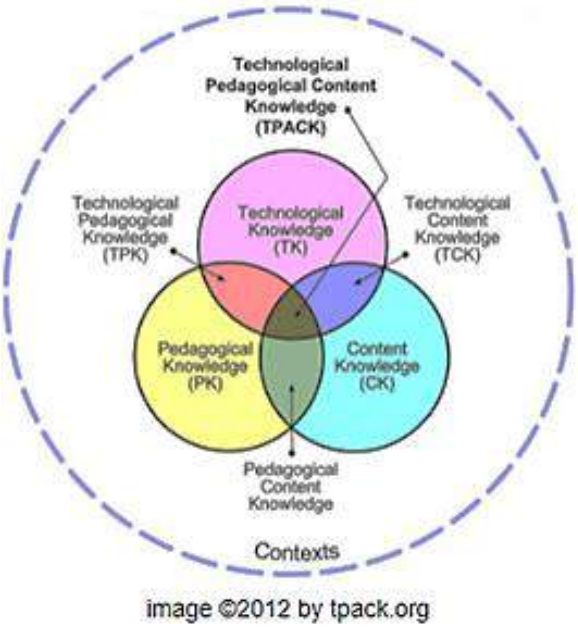

Figure 1. Punya Mishra and Matthew J. Koehler's 2006 TPACK framework

By then, it is also importance that a teacher should consider to hear his/her students' arguments or persuasion as what aspects students wishing to learn and what necessary technology and techniques should he/she (teacher) must learned for him/her in assessing and assisting his/her students in pursuing the main taught or objective as to curriculum structure. Looking forward to this intention a persuasion map as a means of interactive graphic organizer is hereby introduced to be used, see Figure 2. Persuasion Map Template (Koehler et al., 2014).

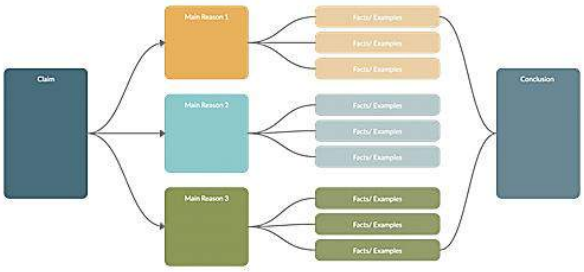

Figure 2. Persuasion Map Template (19 Types of Graphic Organizers for Effective Teaching and Learning, n.d.

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The persuasion map is an interactive graphic organizer that helps students familiarize themselves with the process of persuasive writing. It assists them with outlining and preparing arguments for their essays, speeches, debates, etc. Basically, this organizer has the following steps:

- Step 1: Choose a topic of interest for your essay/debate. Do proper research around it to collect enough information;
- Step 2: Define the claim that you want to make with your essay. Start your persuasion map by writing this down first;
- Step 3: Next to it, write down the reasons for making that claim;
- Step 4: Then write down facts, examples, and information to back up your reasoning; and
- Step 5: End your persuasion map with the conclusion of your essay.

This said persuasion map would allow students to write his claims on what topics should he/she wishes to learn, and right his/her factual arguments for him/her to be understood. Whereby, teachers also would be able to understand his/her students' limitations and difficulties in math and science.

Key Target beneficiaries and their profile including key characteristics/demographic and rationale for choosing them as the beneficiary.

Table 1. DepEd Teachers Mainit National High School

	Educational Attainment			***Marital Status***			***Gender***	
	BS	*MA*	*Ph.D.*	*S*	*M*	*O*	*M*	*F*
Math Teachers								
Science Teachers								
Other filed specialization								

Note: This tabulation are expected to be fill-in once data are gathered thru survey questionnaire (see appendix 1) using ambiguous question.

Using purposive sample out 65 Faculty members of MNHS Teachers it expected that at least there are 30 high school teacher's respondents joined to answers the structured ambiguous question thru Appendix 1. Teacher's Technology Pedagogical Content Knowledge (TPCK) Survey. Wherein, they honestly extended their insights about teaching math or science as to the TPCK.

Table 2. DepEd Students Mainit National High School

	Educational Attainment			***Marital Status***			***Gender***	
	BS	*MA*	*Ph.D.*	*S*	*M*	*O*	*M*	*F*
Math Students								
Science Students								
Other filed specialization								

Note: This tabulation is expected to be fill-in once data are gathered thru persuasive map survey questionnaire (see appendix 2) using ambiguous question.

Using purposive sample out the thousands numbers of students of MNHS it is expected that at least there are 10% or more or less 100 high school students' respondents joined to answers the structured persuasive map with ambiguous question. Wherein, they honestly extended their insights about teaching math or science as to the TPCK.

ACKNOWLEDGEMENT

We are very grateful to Dr. Monalisa T. Sasing, the Faculty in-charge of the EDSC 305 course who are determined of providing instructions, directed his/her students for sharing their thoughts with regards to their understanding on Technology Pedagogical Content Knowledge (TPCK). This deeds simply motivated us to write an article with a concept note as an output. It is also our fervent privilege to honor the Commission of Higher Education (CHED) at all-time for the scholarship grants thru SIKAP advisory that delighted us to pursue our Philosophy of Education (Ph.D.) endeavor in the University of the Philippines, Open University (UPOU), Los Baños, Laguna, Philippines. And also to the Department of Education (DepEd) who are in one way of pursuing research activities for their faculty to involve and took challenges onward to their personal development as to TPCK on their field of specialization, ended by essence this was a collaborative among the authors from UPOU Ph.D. students and DepEd teachers.

CONCLUSION AND RECOMMENDATION

As per advised from Dr. Monalisa T. Sasing, the Faculty in-charge of the EDSC 305 course, University of the

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Philippines, Open University (UPOU), Los Baños, Laguna, Philippines. The Philosophy in Education (Ph.D.) students has given the task to draw a concept note as output, and serve to be their final examination. Thus, basically students who took ESDC 305 course during the Second Semester, AY 2020-2021, of the UPOU were advised to read issues on teacher mentoring and supervision, and quality of supervision which mainly relative to science and mathematics.

In the light of the findings, it reveals that drawn concept note (see Appednix.1) adhered explanatory sequential mixed method design (Subedi, 2016) in gathering data to resolute issues and concerns in relation to science and mathematics mentoring and supervision and that concept note considered as a visual tool that could give good insights in the context of technology pedagogical content knowledge evaluation. This also serve to be the basis in uncovering students' issues and concerns towards their difficulties of the course, their teachers' pedagogy. For future works, it is best to recommend the use of this concept note if incase another phases of studies are necessary. And eventually, in conceptualizing concept note in order to explore reality or evidence perspective of the target beneficiaries/respondents that would redound to acquired data which contemplates to: explain the roles of instructional leaders; define quality supervision; identify key issue in supervising science and mathematics teaching; and differentiate supervision from mentoring.

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