STUDENTS' PERCEPTION ON SCIENCE TEACHING PEDAGOGY IN PHILIPPINE SCHOOL OVERSEAS QATAR: IMPLICATIONS FOR INNOVATIVE STEM CLASSROOM PRACTICES

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ABSTRACT

Students' perception in teaching serves as a powerful tool in evaluating teachers' performance and formative reviews. This research paper aimed to study the impacts of how teachers taught STEM science subjects to students and how teacher pedagogy affected the students learning. The study followed a descriptive research design, which was quantitative in nature. It was conducted in selected PSOs in Qatar with a total of 143 respondents from Junior and Senior HS selected using stratified random sampling. The instrument used was Student Instructional Report II. Frequency distribution, weighted mean, and percentage were used as statistical tools. Based on the results, the impacts of how STEM teachers teach science offers a positive feedback. Teachers' pedagogy affects how students perceived their subject to be; if the organization and planning of the subject was ineffective, students would then perceive that the subject is difficult. The evaluation results suggest a continuous monitoring of classroom instruction and teaching strategies are required. Teachers should follow the new trends in STEM pedagogy, where it follows a collaborative, integrative, constructivist, and reflective approach for authentic and interactive learning. Most of the respondents learn through audio-visual techniques, laboratory exercises, simulations, group discussions, and the use of computers and technology. Encourage further communication with the students, as it is a vital part of the relationship of teaching.

Keywords: Classroom assessment, evaluation, learning experiences, STEM pedagogy, and teaching modalities

INTRODUCTION

The 2030 Sustainable Development Plan highlighted teachers as the foundation for developing education. The activities of teachers are greatly influenced by their beliefs system and perceptions (Thi To Khuyen, N. G. U. Y. E. N., Van Bien, N. G. U. Y. E. N., Lin, P. L., Lin, J., & Chang, C. Y., 2020). In order to promote effectively the agenda on innovation in Education

(SDG 9), it is necessary to recognize teachers' perception on STEM development, implementation, competencies, and difficulties. This will ensure that every classroom follows the design for innovative STEM classroom. In support with the International agenda, President Rodrigo Roa Duterte signed the Republic Act No. 11293 or known as Philippine Innovation Act. As stated in Section 2, letter c to wit:

> *"Investments in education, science, technology and innovation shall be guided by a strategic direction towards strengthening the country's knowledge-based economic development that benefits all. Innovation starts with a robust pool of skilled, talented and creative people. Educational institutions, private organizations, government agencies and local government units (LGUs) are key drivers of programs that stimulate innovation literacy and skills development for the Filipino workforce and entrepreneurs, including women and the youth".*

The integration of STEM subject across all levels in the secondary level in the existing curriculum standards in DepEd in lieu of helping the country in promoting innovation and research are limited (Ling, Pang, & Lajium, 2019). For people to make educated, evidence-based decisions and be engaged completely in an increasingly technological world, a good basic STEM education is important (Radeva, n.d). In order to fulfill UN ambitions for a sustainable future, it is needed to put new approaches to education into practice. New approaches need to be developed and action plans to prepare for the future, and how this can change or adjust the curricula, the activities, and how to teach and interact with children (About the sustainable development goals., n.d.).

The students' teaching assessments offer both summative and formative reviews. Students were optimistic and viewed the assessment process as successful and appropriate for evaluating teaching. Students identified teacher behavior, and course characteristics as variables that could affect the process. Science, Technology, Engineering, and Mathematics (STEM) pedagogy illustrates a wide integration of inquiry-based instruction that deeply engages students to think of future application of science in the modern era (Crippen, & Archambault, 2012). A modern approach to learning that incorporate different technology that is suited in education and student learning. Technology can be part of a scaffolded inquiry-based instruction from motivation, student activity for collaboration and assessment. But most importantly it can give the data of students' progress and can address gaps in real-time.

Based on Baumert et al. (2010), and Voss, Kunter, and Baumert (2011), better content knowledge of teachers may result in higher student achievement. Pedagogical content knowledge has more impact on student achievement than content knowledge; only pedagogical content knowledge seems to have an impact on the quality of instruction. Higher general pedagogical/psychological knowledge results in a higher quality of instruction according to student perception (e.g. higher cognitive activation, better instructional pacing, and better student-teacher relationships). Similarly, as suggested by Bhattacharjee (2015), there are principles that guide to a more conducive teaching and learning process such as learning is a search for meaning. This starts with contextual analysis of certain issues from which students try to construct knowledge. In addition, it cites that meaning requires understanding wholes as well as parts. The teaching-learning process should have geared towards main concepts rather than separated facts. It is very essential that teachers understand the mental models being given by the students through perception of the world and assumptions made by the students to support these models; and crucial to the theory of constructivism is the learner's ability to construct his or her meaning by not just memorizing 'right' answers and repeating someone else's meaning.

Dedicated to the philosophies of this learning theory, teachers aimed for the development of understanding among the students through careful development of various learning activities that stimulate dynamic student participation. Different learning activities have been conceptualized to thoroughly activate prior knowledge on essential information and concepts; and build connection to new knowledge being introduced in the lesson through personalized activities (Chan, et al., 2020).

Considering the teacher's awareness on STEM pedagogy, their pedagogical knowledge, and understanding of how teachers should prepare are taken into consideration in order to comply for the requirements of STEM Education. Therefore, it is essentially connected to the effectiveness of STEM delivery in their own classroom preparation (Bell, 2016). Gomez, & Albrecht, (2013) also explained that, redesigning educational experiences of students may able to help in creating an environment suitable for learner collaboration, technological literacy and academic success and enabling teachers and administrators to assess the performance of their schools. This may lead to a paradigm shift and making the integration of STEM concepts and processes more seamless for both educators and their students (Donna, 2012).

Broadly speaking, teacher preparation has been regarded as a paradoxical panacea for improving school curriculum and teaching and learning, while at the same time being exposed to critiques that call into question its efficacy in training high-quality teachers for the 21st century (Flores, 2016). Refining teaching and learning requires Investment in high-quality collective teacher education with comprehensive proven expertise and training (Darling-Hammond, 2013). This initiative will give the idea on what really is happening in the classroom. This research aimed to provide insights on actual scenario in a classroom setting. The students' perception on teaching pedagogy of teachers will verify the needs in a more in-depth program that will support educators in pursuing a quality instructional delivery in STEM education.

OBJECTIVES OF THE STUDY

The main purpose of this study was to determine the perception of the students in the Science teaching pedagogy used by teachers in their classroom with the purpose of instituting an innovative STEM classroom practices. Specifically, it sought (1) to determine the impact of teaching pedagogy of teachers to students in terms of students' expectations and interest; (2) to assess the students' perceptions on teachers' pedagogy in terms of: course organization and planning; assignments, exams and grading; instructional methods and materials; course outcomes; student effort and involvement; course difficulty, workload, and pace; and (3) to identify the common mode of delivery in STEM classroom.

METHODOLOGY

The study followed a descriptive research design, which is quantitative in nature. Nassaji, (2015) defined a descriptive research design as helping to provide answers to the questions of who, what, when, where, and how associated with a particular research problem. This study relied heavily on the survey questionnaires that were distributed among students from Grades 7 to 11. The survey questionnaires were adapted from the Educational Testing Service's Student Instructional Report II. The researchers used stratified random sampling using the fishbowl method and drew one section from each grade level, which was then the main respondents who were given the survey questionnaires. The researchers selected the respondents by dividing the population into smaller groups – which were the sections for each grade level. This sampling technique increased the validity of the statistical findings. The questionnaire, the principal source of data of this study sought to answer the research questions of the study. The survey-questionnaire that was used was the Student Instructional Report II. It was a course evaluation survey that helped in evaluating students' perceptions on their learning experience. The questionnaire used published by National Academy of Science, "Evaluating and Improving Undergraduate Teaching in Science, Technology, Engineering, and Mathematics." All parts of the survey followed a

5-point scale, with differing statements. Parts A, B, C, D, and E were lists of statements that asked the respondents to assess the effectiveness of the course. The statements for the 5-point scale in parts H, I, and J differed for every question as it was subjective in part of the respondent, while part K was an optional part wherein supplementary questions were provided when necessary. Part L included student comments, which was not applied in this particular study.

The validity and reliability of the Student Instructional II report was done by the Educational Testing Service (ETS), the creator of the instrument. Three kinds of reliability analysis yielded positive results. A Coefficient Alpha analysis indicated that the items of the survey were interrelated. An item-level reliability analysis examined that the SIR II report yields consistent evaluation even when used in several small classes. The third type, the "test-retest", measured the extent to which responses remain stable over short periods of time, and sufficiently produced uniformly high correlations. Thus, the pilot testing of the SIR II report demonstrated positive results for the three kinds of reliability.

In the study, the researchers asked permission from the Senior High School Department Head for permission from their good office in floating the instrument, the Student Instructional Report II. The researchers then personally administered the survey to the chosen sections from the Junior High School and Senior High School departments. After seeking the permission of the offices, the researchers scheduled the conduct of the survey to each section at a time when a science teacher will not be present, so as to prevent bias. During the conduct of the survey, they explained that the information will remain confidential throughout the conduct of the study and that the respondents will remain anonymous. Once all the data had been gathered, the researchers tabulated the raw score and applied the statistical treatments to analyze the results of the survey. The data that were yielded by the questionnaires were tallied, tabulated, and subjected to the following statistical treatments in order to ensure validity and reliability of results. Frequency distribution, weighted mean, and percentage were used as statistical tools.

RESULTS AND DISCUSSION

From the research problem and answers to the questions posited in the study, the major findings can be summarized as follows:

1. Impacts of STEM teachers' pedagogy on students' interest and expectations.

Table 1
Impacts of STEM teachers' pedagogy on students' interest and expectations

GRADE LEVEL	CHOICES							TOTAL	VI
	A	A-	B+	B	B-	C	BELOW C		
Grade 7	44%	19%	33%	4%	0%	0%	0%	100%	A (93%-99%)
Grade 8	11%	11%	43%	21%	11%	0%	3%	100%	B+ (87%-89%)
Grade 9	6%	10%	30%	27%	7%	17%	3%	100%	B+ (87%-89%)
Grade 10	28%	10%	31%	17%	7%	0%	7%	100%	B+ (87%-89%)
Grade 11	45%	24%	24%	7%	0%	0%	0%	100%	A (93%-99%)

Results are shown in Table 1. Based on the responses of the students in the question, "What grade do you expect to receive in this course?", majority Grade 7 respondents expect to receive an A grade, the majority of Grade 8, Grade 9, and Grade 10 respondents expect to receive a B+ grade respectively, while the majority of Grade 11 STEM A expect to receive an A grade. It can be construed that if the way teachers teach were effective, the grades students would expect to receive were high, since they were absorbing the information being taught to them as well as their efforts had paid off. A pedagogy that needs improvement could adversely impact the students, causing them to think independently about the subject and essentially self-teach. An example of this was that of the Grade 8 respondents, wherein they responded that their learning was less than most courses, and their interest in the course was much less than most courses, while they were immensely challenged by the course. It could also be that they were putting the same amount of effort as they did in other subjects.

2. Science pedagogy and student learning

Table 2
Students' perceptions on teachers' pedagogy

PARTS	GRADE LEVELS				
	Grade 7	Grade 8	Grade 9	Grade 10	Grade 11
A. Course Organization & Requirements	4.4 (E)	3.4 (ME)	4.3 (E)	4.5 (VE)	4.1 (E)
B. Communication	4.3 (E)	3.3 (ME)	4.3 (E)	4.3 (E)	4.1 (E)
C. Faculty/Student Interaction	4.4 (E)	3.6 (E)	4.2 (E)	4.4 (E)	4.4 (E)
D. Assignments, Exams & Grading	4.2 (E)	3.5 (E)	4.2 (E)	4.3 (E)	4.1 (E)
E. Supplementary Instructional Methods	4.1 (E)	3.3 (ME)	3.9 (E)	4.1 (E)	4.2 (E)
F. Course Outcomes	4.1 (MMC)	3.2 (AS)	4.1 (MMC)	4 (MMC)	3.9 (MMC)
G. Student Effort & Involvement	3.9 (MMC)	4 (MMC)	4.1 (MMC)	4.2 (MMC)	3.9 (MMC)
H. Course Difficulty, Workload, and Pace					
For my preparation and ability, the level of difficulty of this course was:	3 (AR)	4.1 (SD)	3.6 (SD)	3.9 (SD)	3.4 (AR)
The workload for this course in relation to other course in equal credit was:	3.3 (AS)	3.7 (H)	3.7 (H)	3.6 (H)	3.2 (AS)
For me, the pace at which the instructor covered the material during the term was:	3.3 (AR)	3.7 (SF)	3.4 (AR)	3.3 (AR)	3.2 (AR)
I. Overall Evaluation	4.1 (E)	2.9 (ME)	3.5 (E)	4.1 (E)	4.2 (E)

**Abbreviations: E (Effective), ME (Moderately Effective), MMC (More than Most Courses), AS (About the Same), AR (About Right), SD (Somewhat Difficult), SF (Somewhat Fast), and H (Heavier).*

Results are shown in Table 2. Based on the results of the frequency of distribution of data for Part A: Course Organization and Planning and Part G: Student Effort and Involvement, the more prepared an instructor was and the command he/she had over the course material reflected on how much effort they poured on learning the subject. This could also be related to

Part F: Course Outcomes, wherein a student would feel that their learning increased or decreased based on their instructor's way of explaining and summarizing the key concepts of the lessons, and Part H: Course Difficulty, Workload, and Pace. A stark example was for the Grade 8 Courage respondents, where they responded that their instructor's explanation of course requirements, preparation for each class period, command of the subject matter, use of class time, and way of summarizing/emphasizing the important points were all moderately effective. Due to this, they responded that they put more effort and preparation into the subject than most subjects, and that they were more challenged by the subject than most subjects. They also professed that their learning and interest in the subject had remained about the same and responded that the course was somewhat difficult, the workload was heavier compared to other courses of equal credit, and the pace that their instructor covered the material was somewhat fast.

3. Modes of the delivery of lessons in STEM class

Table 3
Common mode of delivery in STEM classroom

Supplementary Instructional Methods	GRADE LEVELS				
	Grade 7 (Mean)	Grade 8 (Mean)	Grade 9 (Mean)	Grade 10 (Mean)	Grade 11 (Mean)
1. Problems or questions presented by the instructor for small group discussions	4.3	3.5	4.1	4.1	4
2. Term paper(s) or project(s)	4	3.3	4.2	4	4.1
3. Laboratory exercises for understanding important course concepts	4.4	2.8	4.5	3.8	4.4
4. Assigned projects in which students worked together	4.6	3.7	4.2	4.4	4.4
5. Case studies, simulations or role playing	4	3.4	3.3	3.9	4.1
6. Course journals or logs required of students	3.2	3	3.8	3.9	3.8
7. Instructor's use of computers as aids in instruction	4	3.6	3.5	4.3	4.3
Average	4.1	3.3	3.9	4.1	4.2
Verbal interpretation	Effective	Moderately effective	Effective	Effective	Effective

According to the students' responses, the delivery of lessons in their respective classes involved social interaction and information processing, which in turn helped students who learned through visuals and audio. Most of the supplementary instructional methods used were small group discussions, term papers and projects, assigned group projects, and the use of computers, while higher grade levels used case studies and course journals or logs as well.

Overall, there were minimal changes needed in order to yield a better STEM pedagogy for most grade levels. However, based on the frequency distribution of the data of Grade 8 respondents, the pedagogy of their science teacher was moderately effective, achieving an average weighted mean of 2.9. Specifically, the instructor's comments on assignments and exams, the helpfulness of assignments in understanding the course material, the instructor's helpfulness and responsiveness to students, the instructor's way of summarizing important points, the use of examples or illustrations, and the information given to students on how they would be graded needed improvement.

CONCLUSIONS

In view of the foregoing findings, the following conclusions are drawn:

1. Since most of the respondents responded that their teacher's science pedagogy is effective, the students absorb their lessons and their course material in a way that positively reflected on their grades. Thus, they expect that they would garner higher grades because of they understood the concepts and lessons well and the efforts they put into the subject paid off.
2. An instructor's science pedagogy affects how students perceived their subject to be. If an instructor's organization and planning of the delivery of the course material is rendered to be ineffective by the students, they would then perceive that the subject is difficult, that their workload was heavier, and that they were challenged by the subject more than most subjects.
3. Based on the answers of the respondents in Part E: Supplementary Instructional Methods, the design of the delivery of the lessons in K-12 was through social interaction and information processing, wherein the students would be grouped for projects and discussions, and they would be processing information in unique ways, such as through the use of technology and simulations or role-playing.
4. Based on the results of the study, there are minimal factors that needed improvement for most grade levels because they evaluated such factors as effective. An exception is made for the Grade 8 Courage respondents, where they responded that their instructor's way of summarizing/emphasizing important points, his/her ability to make clear and understandable presentations, the use of examples or illustrations to clarify course material, his/her helpfulness and responsiveness, his/her comments on assignments and exams and the helpfulness of assignments in understanding the course material are all in between moderately effective -- tethering on somewhat ineffective -- and ineffective. These factors need improvement in order to yield a better science pedagogy for the next batch of students.

RECOMMENDATIONS

In light of the findings and conclusions of the study, the following recommendations are drawn:

1. A focused group discussion may be employed to be spearheaded and conducted by the respective school heads, to be attended by the faculty of the Junior High School and Senior High School departments and by the administration, in order to bring to light the impacts of how science teachers teach science to students and technology integration.
2. Continuous monitoring of classroom instruction and teaching strategies, particularly in science subjects, by the respective school heads is suggested to follow the new trends in science teaching, where it follows a collaborative, integrative, constructivist, and reflective, and applications of science and technology for authentic and interactive learning.
3. Teachers may add a self-assessment of their pedagogy along with continuous monitoring of classroom instruction in order to evaluate themselves if they are able to organize and prepare themselves and their materials in teaching the science subject.
4. Encourage further communication with the students, as it is a vital part of the relationship of teaching. Students are more likely to be active in classes when they see that their instructor takes their opinions and comments

into account, and when they see improvement based on these opinions and comments. Students are also more likely to be active in class if the class discussion is understandable, interactive, and the teacher takes his/her time to clarify the concepts through illustrations and presentations.

5. A professional development plan may be created for the benefit of the teachers whose effectivity of teaching pedagogy ranked between moderately effective and ineffective. This will help the teachers to improve their teaching pedagogy in order for the students to absorb their lessons, and the school to raise the standards of the science pedagogy of teachers.

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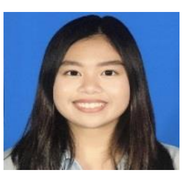

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