Teachers' Awareness and Students' Analytical Skills in Mathematics in Senior High Schools in Zambales Zone IV

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***Abstract*— This study seeks to gauge the teachers' readiness in Mathematics in senior high school and students' analytical skills in Zone IV in the Division of Zambales. There were 3 teachers and 296 senior high school students who were involved in this study from three schools. The study made use of a descriptive-correlational research design utilizing a researcher-made survey questionnaire and analytical test. Data were analyzed using various statistical methods. Results of the study showed that the mathematics teachers in the senior high school are ready in terms of teaching experience (4.40), professional training (3.80), instructional tools (4.33), pedagogical content knowledge (4.00), and interpersonal connectedness (3.67). The level of analytical skills of Mathematics students is "approaching proficiency" as revealed by the overall score of 9.26 (out of 15 items) with a standard deviation of 2.40. There is a statistically significant correlation between interpersonal connectedness and instructional tools ($r=-0.996$; $p<0.05$). There is no statistically significant correlation between students' teachers' readiness and students' analytical skills. After careful analysis of the study, this study recommends that instructional tools and materials be adequately provided so that both teachers and students will be able to attain the learning targets more effectively. Students' analytical skills must be enhanced more as they gear towards the challenges of 21st-century society. This can be done through designing inquiry-based, outcomes-based, and student-centered instructional plans. Schools may be encouraged to conduct Learning Action Cell (LAC) sessions related to designing instructional tools in Mathematics, improving student-teacher connectedness in Mathematics teaching, and mentoring sessions among teachers. Further studies may be conducted to validate the results of the study. More teacher-respondents may be considered in future studies.**

***Keywords*— analytical skills, instructional tools, interpersonal connectedness, pedagogical content knowledge, professional training, teaching experience, teachers' readiness**

I. Introduction

The 21st-century society mainly demands the development of students' critical and creative thinking to cope up with the fast-paced technological world. All countries but two adopt a 12-year basic education cycle before students can pursue higher education. The inclusion of a specialized curriculum in Grade 11 and Grade 12 under the senior high school makes the learning experiences of students very relevant, meaningful, and timely. In the ASEAN Region, the Philippines was the last country that shifted its 10-year pre-university education to 12 years, adding two years for the senior high school (SHS). The adoption of the SHS was legally mandated by Republic Act 10533 otherwise known as Enhanced Basic Education 2013. In the School Year 2016-2017, the Philippines piloted the Senior High School in the public and private secondary schools. Various tracks were offered for the students to choose the best track for their holistic development.

The Department of Education stated that Senior High School students will go through a core curriculum and subjects under a track of their choice. The two additional years will equip learners with skills that will better prepare them for the future, whether it be employment, entrepreneurship, skills development (further tech-voc training), or higher education (college). The Senior High School covers eight (8) learning areas as part of its core curriculum and adds specific tracks which are similar to college courses. One of the learning areas is Mathematics. The Mathcore learning area is composed of two subjects which include General Mathematics and Statistics and Probability. Each subject requires 80 hours per semester. Mathematics is learned through problem-solving, and mathematical ideas develop along with problem-solving capabilities during the problem-solving process [17].

Doing mathematics requires logical thought and trains students to think both critically and creatively. In school, students usually encounter specific problems that apply to the topic at hand, in addition, the thought process that goes into understanding the problem, differentiating what is essential from what is not, being able to make connections among the given information to generate a solution and verifying its accuracy is surely something that students can apply even in non-mathematical settings [21]. A mathematically competent student does not only know how to compute and perform algorithms but is also able to pose and solve mathematical problems and apply mathematical skills and reasoning in other subjects and everyday experiences. The student can see patterns in diverse phenomena and connects mathematics to other learning by

understanding the interrelationships of mathematical ideas and the uses of math in other areas [21]. [22] cited that teaching involves what has come to be called situated knowledge [19]. Situating knowledge within preparation for the practice of teaching mathematics refers not only to the varied classroom settings in which teachers ultimately practice but also to the following: teachers' own prior primary and secondary schooling; the courses in which university-level content knowledge of mathematics is acquired; the courses in which the pedagogy of teaching mathematics is most emphasized; the classroom contexts for acquiring learning about mathematics in teaching during field experiences; and special arrangements for internships.

Statement of the Problem

This study sought to gauge the teachers' readiness in Mathematics in senior high school and students' analytical skills in Zone IV in the Division of Zambales.

Specifically, it sought to answer the following research questions:

1. What is the level of teachers' readiness in Mathematics in senior high school in terms of:
   1.1 Teaching Qualification;
   1.2 Pedagogical Content Knowledge;
   1.3 Professional Training;
   1.4 Instructional Tools; and
   1.5 Interpersonal Connectedness?
2. What is the level of analytical skills of students in senior high school mathematics?
3. Is there a significant relationship among the readiness variables?
4. Is there a significant relationship between teachers' readiness and students' analytical skills in mathematics?

II. Materials And Methods

A. Research Design

The study used a descriptive-correlational research design through survey questionnaires and the test as the main tools. The results were
triangulated through interview and focus group discussion.

B. Respondents

The respondents of the study were Grade 11 Mathematics teachers and students randomly sampled from the three selected secondary schools in Zone IV Division of Zambales. Table 1 shows the distribution of the respondents.

TABLE I
DISTRIBUTION OF RESPONDENTS

School	Teachers			Students		
	N	n	%	N	n	%
Castillejos National High School	8	1	33.33%	200	149	50.34%
Subic National High School	13	1	33.33%	350	83	28.04%
San Guillermo National High School	7	1	33.33%	225	64	21.62%
Total	**28**	**3**	**100.00**	**775**	**296**	**100.00**

C. Research Instrument

Likert scale-type survey questionnaire and the achievement test served as the main instruments in gathering the data. The teachers' readiness questionnaire is composed of the demographic profile of the teacher-respondents as to their gender, school, and courses handled; the extent of readiness of teachers as to teaching experience, Pedagogical content knowledge, professional training, instructional tools, and interpersonal orientation and a structured interview questions which gauged more the teachers' readiness in handling Mathematics courses in the senior high school. The Analytical Skills Test measured the students' analytical skills. Composed of 15 items, the score intervals have the corresponding level of students' analytical skills.

D. Data Gathering Procedure

Development and validation of the research questionnaire were formulated before seeking permission and approval to conduct the study. Parental consent was secured for the student – participants and assented from the teacher – respondents for ethical purposes. The researcher administered the survey questionnaire and interviewed focus group discussions with the teachers.

III. Results and Discussions

Teachers' Readiness in Mathematics in Senior High School

The level of teachers' readiness in Mathematics in senior high school as to teaching experience is shown in Table 2.

TABLE II
TEACHERS' READINESS IN SENIOR HIGH SCHOOL IN TERMS OF TEACHING QUALIFICATIONS, PROFESSIONAL TRAINING, AND INSTRUCTIONAL TOOLS

Teacher's Readiness	Mean	sd	VI
Teaching Qualification	4.40	0.14	Ready
Professional Trainings	3.80	0.34	Ready
Instructional Tools	4.33	0.19	Ready

Legend: 1.00-1.49 (Not Ready); 1.50-2.49 (Slightly Ready); 2.50-3.49 (Moderately Ready); 3.50-4.49 (Ready); 4.50-5.00 (Absolutely Ready

As shown in Table 2, the teacher-respondents are "ready" about teaching qualification (M =4.40),

professional training (M= 3.50), and instructional tools (M = 4.33).

Teaching Qualifications

Several studies have been published and revealed that teaching experience is positively associated with student achievement gains throughout a teacher's career [13]. Gains in teacher effectiveness associated with experience are most steep in teachers' initial years, but continue to be significant as teachers reach the second, and often third, decades of their careers. Teacher academic preparation, certification type, and years of teaching experience, among others, are often taken as indicators of teacher quality [8]. Licensed teachers are also considered to be effective [10] because licensing typically requires prospective teachers to hold a college degree in pedagogy and the subject, they wish to teach [8]. Moreover, teachers who work in schools with strong professional environments improve in their effectiveness in teaching mathematics at much faster rates than their peers working in schools with weaker professional environments [13].

Professional Training

The findings support the study of [1] that to be effective, teachers need a combination of professional knowledge and specialized skills as well as their personal qualities and experiences. Moreover, acquiring new skills and adding to their knowledge are among the major reasons are teachers endeavor to attend activities designed for professional development.

Instructional Tools

The role of instructional tools in terms of the promotion of meaningful communication contributes to effective learning and its role for students' retention, thus making learning more permanent. Instructional tools also help to overcome the limitation of a classroom by making the inaccessible accessible [5]. Instructional materials have been found to enhance the quality of the learning experience for learning in many ways. Among them are; the improved multi-sensory and multi-image factors responsible for the inability of teachers to improvise instructional materials for teaching and learning [23].

TABLE III
LEVEL OF TEACHERS' READINESS IN MATHEMATICS IN TERMS OF PEDAGOGICAL CONTENT KNOWLEDGE AND INTERPERSONAL CONNECTEDNESS

Teachers' Readiness	Frequency of Correct Answer	%	VI
Pedagogical Content Knowledge	13	86.67	Absolute Ready
Interpersonal Connectedness	10	66.67	Ready

Legend: 0 -20% (Not Ready); 21-40% (Slightly Ready); 41-60% (Moderately Ready); 61-80% (Ready); 81-100% (Absolutely Ready)

Table 3 shows that teachers are "absolutely ready" in terms of pedagogical content knowledge (86.67) and in terms of interpersonal connectedness (66.67) the teachers are ready.

Pedagogical Content Knowledge

Pedagogical content knowledge (PCK) includes knowledge (a) about how to best represent and explain the subject matter to students, as well as (b) knowledge about students' conceptions and misconceptions to optimally adapt instruction to students [2]. Teachers with sufficient academic preparation are seen to be competent in subject matter content and pedagogical skills enabling them to be effective in classrooms and produce larger student achievement gains [6]. Recent empirical studies [3] [11] [15] emphasized the importance of teachers' pedagogical content knowledge for the design of effective learning environments. The influence of pedagogical content knowledge on mathematical achievement was mediated by the provision of cognitively activating instruction. Thus, teachers with high pedagogical content knowledge were more able than teachers with low pedagogical content knowledge to provide instruction that was cognitively challenging for students and therefore better-supported students' learning [16].

Instructional Tools

[5] explains the role of instructional tools in terms of the promotion of meaningful communication which contributes to effective learning and its role for students' retention, thus making learning more permanent. Instructional tools also help to overcome the limitation of a classroom by making the inaccessible accessible. Instructional materials have been found to enhance the quality of the learning experience for learning in many ways. Among them are; the improved multi-sensory and multi-image factors responsible for the inability of teachers to improvise instructional materials for teaching and learning [23].

The teachers likewise cited the challenges and issues they have encountered in teaching Mathematics in senior high school.

1. *"Lack or absence of learners' materials and teaching guide."* [MT1, MT2, MT3]
2. *"More time to prepare visual aids since lessons are to be downloaded."* [MT2]
3. *"Spent more money for the pocket wifi for me to download my topic."* [MT2]
4. *"Students retention to previous lessons."* [MT3]

Based on the responses of teachers, their first major challenge is the lack of materials and teaching guides. The teachers have difficulty in teaching some concepts in Mathematics. They tend to teach the lesson based on what they understand. It is a burden for the teachers to study the concepts and then discuss them later with the students. It is expected then that this will give rise to other difficulties which are demanding because materials are not accessible to everyone. The activities are very time-consuming especially when the students have no prior knowledge about the present lesson and there is a need to reintroduce the last lesson before the present lesson is achieved.

Level of Analytical Skills of Mathematics Students

TABLE IV
LEVEL OF ANALYTICAL SKILLS OF MATHEMATICS STUDENTS

Score	f	%	VI
13 - 15	27	9.12	Advanced
10 - 12	110	37.16	Proficient
7 - 9	117	39.53	Approaching Proficiency
4 - 6	42	14.19	Developing
Overall	296	100.0	9.26 (Approaching Proficiency)

Legend: 1-3 (Beginning), 4-6 (Developing), 7-9 (Approaching Proficiency), 10-12 (Proficient), 13-15 (Advanced)

As gleaned from the table, the level of analytical skills of Math students is "approaching proficiency" as revealed by the overall score of 9.26 with a standard deviation of 2.40, which indicates relatively heterogeneous scores from developing to advanced levels. In particular, there are 117 students (39.53%) who are approaching proficiency in terms of analytical skills, 110 students (37.16%) are proficient, 42 students (14.19%) are developing and only 27 students (9.12%) are in the advanced level. Based on the test results of the analytical skills test, students mostly got correct answers on Basic Business Mathematics content, which indicates that learners can investigate, analyze and solve involving business-related problems. Logic content got the least number of correct answers which means that students need an appropriate application method of logic in a real-life situation. Analytical skills were used to describe a student's ability to conclude syllogistic format [7]. [4] analytical and communicative skills required from a teacher should be part of a mathematics graduate's toolkit—but we do not give our students all the tools. Teachers have to give feedback to their students—but to appreciate the value of feedback; they have to experience efficient and supportive feedback from their teachers.

Relationship among the Readiness Variables

TABLE V
CORRELATIONS AMONG THE READINESS VARIABLES

Variable	Teaching Qualification	Professional Training	Instructional Tools	Pedagogical Content Knowledge
Teaching Qualification	-			
Professional Training	0.143	-		
Instructional Tools	0.545	0.908	-	
Pedagogical Content Knowledge	-0.756	-0.756	-0.961	-
Interpersonal Connectedness	-0.619	-0.866	-0.996*	0.982

**Correlation is significant at the 0.05 Level (2-Tailed)*

Table 5 shows a statistically significant correlation between interpersonal connectedness and instructional tools (r=-0.996; p<0.05). The teachers' readiness in terms of interpersonal connectedness and instructional tools have a negative but very high correlation. This may imply that as teachers' readiness in interpersonal connectedness increases, their readiness in instructional tools tends to decrease.

Relationship between teachers' readiness and analytical skills of students

Other variables were found to have no significant relationships among one another despite having large correlation coefficients due to a small sample size. Only three mathematics teachers handling senior high school classes served as teacher respondents.

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TABLE VI
CORRELATIONS BETWEEN TEACHERS' READINESS AND STUDENTS' ANALYTICAL SKILLS

Correlations	Teaching Qualification	Professional Trainings	Instructional Tools	Pedagogical Content Knowledge	Interpersonal Connectedness
Students' Analytical Skills	0.982	0.327	0.693	-0.866	-0.756

**. Correlation is significant at the 0.05 level (2-tailed); Significant at p<0.050*

The table shows no statistically significant correlation between students' teachers' readiness and students' analytical skills. Although non-significant, it can be noted that teaching experience, professional training, instructional tools, and interpersonal connectedness of the teachers showed a positive relationship with students' analytical skills. Further study may be conducted to explore more on this area. The findings support the study of [24] that the relationship between teacher experience and student achievement is difficult to interpret because this variable is highly affected by market conditions and/or the motivation of women teachers to work during the child-rearing period. The results of the current study also support the study of [12] which revealed that in-service professional development has no relationship to student achievement. Meanwhile, the study conducted by [24] revealed that Mathematics teachers' advanced academic degrees and teachers having a major in the field of teaching seemed to have a negative association with students' outcomes in mathematics. Moreover, studies on the effect of teacher experience on student learning have found a positive relationship between teacher effectiveness and their years of experience, but not always a significant or an entirely linear one [14] [18]. Though some studies oppose the findings of the present study, several studies show a positive relationship between teachers' preparation in the subject matter they later teach and student

achievement [6] [8] [9] while others have less unequivocal results. [18] found both positive and negative effects of teachers' in-field preparation on student achievement. [8] found a positive relationship for students' mathematics achievement. [20] reported a positive relationship between student achievement and teachers with a major in mathematics. [18] however, found that while having a major in mathematics did not affect student achievement in mathematics, having a substantial amount of under-or post-graduate coursework had a significant positive effect on students in physics but not in life sciences.

IV. Conclusion

The study ascertained the level of teachers' readiness in mathematics in senior high school and the analytical skills of students. Mathematics teachers in senior high school are ready in terms of teaching experience, professional training, instructional tools, pedagogical content knowledge, and interpersonal connectedness. Mathematics students' level of analytical skills is approaching proficiency. Teachers' readiness in interpersonal connectedness has a very high negative relationship with their readiness in instructional tools. Furthermore, there is no significant relationship between teachers' readiness and students' analytical skills.

Although Mathematics teachers are ready in teaching mathematics in senior high school, it is recommended that instructional tools and materials be adequately provided so that both teachers and students will be able to attain the learning targets more effectively. Students' analytical skills must be enhanced more as they gear towards the challenges of 21st-century society. This can be done through designing inquiry-based, outcomes-based, and student-centered instructional plans. Schools may be encouraged to conduct Learning Action Cell (LAC) sessions related to designing instructional tools in Mathematics, improving student-teacher connectedness in Mathematics teaching, and mentoring sessions among teachers. Seminars and training relevant to Mathematics teaching, retooling and enhancement programs related to Mathematics and workshops on classroom-based research may be conducted to improve Math teaching. Further studies with more schools and teacher – respondents may be conducted to validate the results of the study.

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