UHD-CTU ANNUAL ECONOMICS AND BUSINESS CONFERENCE PROCEEDINGS - 2017

ISSN: 2472-9329 (Print) 2472-9310 (Online)

EDITORS:

Chu V. Nguyen
Vo Thanh Danh
Keith Wright
Lucille V. Pointer
Stephen Miller
Huynh Viet Khai
Vo V. Dut
Phan Dinh Khoi
Minh Bui

JANUARY 13-14, 2017
COLLEGE OF BUSINESS, UNIVERSITY OF HOUSTON-DOWNTOWN AND COLLEGE OF ECONOMICS, CAN THO UNIVERSITY
Can Tho, Vietnam

Table of Contents

Table of Contents (Continued)

Table of Contents (Continued)

Table of Contents (Continued)

Table of Contents (Continued)

THE UHD-CTU ANNUAL ECONOMICS AND BUSINESS CONFERENCE 2017
ISSN: 2472-9329 (Print) and 2472-9310 (Online)
http://sareb-journal.org

HIGH SCHOOL TEACHERS' LEVEL OF KNOWLEDGE AND SKILLS IN APPLYING MATHEMATICS IN REAL LIFE: AN ASSESSMENT TOWARDS TEACHER'S PREPAREDNESS FOR SENIOR HIGH SCHOOL MATHEMATICS

Melanie Gurat[1*], Cesar Medula, Jr. [1], Dominga Valtoribio [1] and Rommel de Gracia [2,]
[1] Saint Mary's University, Philippines;
[2] Schools Division of Nueva Vizcaya, Philippines
***** Correspondence: melanie.gurat@yahoo.com; Tel.: +639061371980

Abstract: *It is the role of the teacher to teach the students how to develop basic competencies and skills in solving, creative and critical thinkin. Thus, it is the teacher that is considered as one of the factors that could affect the students. This study measured high school teacher's knowledge and skills in applying mathematics in real life using standardized questionnaires. Result revealed that the teachers of schools that will offer academic track have moderate knowledge and below level 1 skill in applying mathematics in real life. It also showed better knowledge for teachers with higher time spent in teaching in mathematics and better skills for higher perception on how students do well in mathematics because of ability, habits, teaching, friends and effort. However, better knowledge and skills were also revealed for teachers with lower effect on the participation in mathematics development activities and professional development in teaching mathematics. Nevertheless, the level of knowledge of teacher in mathematics is not correlated with the competence of the teacher in applying mathematics in real life, manifestation of the teachers' unpreparedness for senior high school. Hence, there is a need for more training for teachers to help them in teaching mathematics in real life.*

Keywords *Mathematics application, curriculum, teachers' preparedness, mathematics literacy*

I. INTRODUCTION

The potential role for the development of individual skills is knowing when and how to use mathematical knowledge for approaching and solving problems in practical situations. Hence, this improved students' mathematical thinking and literacy. On the other hand, the role of a math educators is to let students practice applying mathematics to real-world problems, so that they improve their mathematical thinking and mathematical literacy (Bokar, 2013).

The Department of Education in collaboration with Southeast Asian Ministers of Education Organization conducted comparative studies on educational systems across the globe which resulted to the mandatory implementation of K to 12 reform in the Philippines. K to 12 means Kindergarten and the 12 years of elementary and secondary education. Kindergarten refers to the five-year old cohort that takes a standardized kindergarten curriculum. Elementary education refers to primary schooling that involves six years of education (Grades 1 to 6). Secondary education refers to four years of junior high school (Grades 7 to 10) and two years of senior high school (Grades 11 to 12).The reform commenced during the school year 2012-2013 in all public and

private elementary and secondary schools across the country (DepEd Order No. 31, series of 2012). The rationale for implementing the K12 system cycle is to align our standards of education to that of what is globally accepted.

Proficiency in mathematics was considered as one of President Benigno Simeon C. Aquino III's 10-point education agenda.The twin-goals of Mathematics in basic education are critical thinking and problem-solving. The challenge for mathematics education therefore was to comply with the standards of K to 12 curriculum as stated in its vision of a Filipino learner who possesses sufficient mastery of basic competencies (literacy, numeracy) and skills in problem solving, creative and critical thinking.

With the shift of the curriculum, the current curriculum will be decongested to allow for mastery of learning. Mathematics is a subject that encompasses life at any stage and its value is applied even outside the four corners of the classroom. The recent K to 6 Mathematics curriculum demands that individual must learn comprehensively and with much depth and ensures continuity of learning from K to Grade 10. The two years additional, Grades 11 and 12 provides time for mastery of key mathematics concepts, and provides an opportunity for students to choose advance mathematics as an elective (e.g., engineering and sciences, business and entrepreneurship, technical or applied mathematics).The curriculum has five content areas in the mathematics curriculum. It is also expected that the specific skills and processes developed in the curriculum are: 1) to know and understand; 2) to estimate, compute, and solve; 3) to visualize and model; 4) represent and communicate; 5) conjecture, to reason out, prove, and to make decision, and 6) apply and connect. There will be fewer number of digits that will be involved in operations but the focus will be on understanding, critical thinking, problem solving, reasoning, communicating, and making connections, representations and decisions in real life.

Solving real life problems is important to the students to prepare them for their lives after grade 12. Again, mathematics educators need to promote student thinking that can help enhance individual's mathematical literacy. Felton (2014) states that problems must be authentic and that the teacher must approach activities authentically to encourage students to draw on their real-world knowledge. The importance of the application to real-world has been emphasized at the national and even in the international levels. For instance, Programme for International Student Assessment (PISA) is an international assessment that emphasizes the real-world problem-solving in mathematics part of the assessment.

Meanwhile, students struggle to connect mathematics and their lives. Students face a problem whenever they encounter a new mathematical concept. Moreover, they understand that they need to study the concepts to pass the class; however, they also believe that the concept will have no application to their real life. Consequently, mathematics education as a research field has widely shown that mathematics teachers' behaviors and competencies have significant influenc on students' learning achievements and so any institutional global project focusing on developing mathematical competencies at schools has to be concerned with the even more complex task of developing professional mathematics teaching competencies (Marban, 2009). Thus,

mathematics teachers should therefore be adept at teaching the subject and must be equipped with the necessary skills or strategies needed to improve the competency of the students in mathematics (Braza and Supapo, 2014).

The aforementioned discussion explained the reason why it is also important to explore the high school teachers' knowledge and skills in applying mathematics in real life. The shift to K to 12 curriculum challenges the mathematics educators to integrate the real world problems in their lesson to equip the students with the required skills needed to face the complexity of life through the knowledge and skills in applying mathematics in real life. The teachers' competency in teaching is being assessed through the Licensure Examination for Teachers (LET) but this does not reveal the skills of teacher in applying mathematics in real life. Thus, exploring the teachers' knowledge and skills in real life would determine the preparedness of the teacher in senior high school especially if they are employed in a school that offer academic track for senior high school.

The study aimed to investigate the high school teachers' level of knowledge and skills in applying mathematics in real life. In particular, this study explored answers to the following questions:

1. What is the teachers' level of knowledge and skills in applying mathematics in real life?
2. Is there a significant relationship between teachers' knowledge or skills in applying mathematics in real life and the teacher-related variables, particularly:
    a. Is there a significant difference between teachers' knowledge or skills in applying mathematics in real life when grouped according to personal background particularly sex?
    b. Is there a significant correlation between teachers' knowledge or skills in applying mathematics in real life and the following teacher-related variables:
        i. professional development;
        ii. time management;
        iii. assessment strategies;
        iv. teaching strategies;
        v. students with special needs, and
        vi. attitudes of the teacher towards mathematics?
3. Is there a significant correlation between teachers' knowledge and skills in applying mathematics in real life?

II. MATERIALS AND METHODS

This study was descriptive-correlational type and made use of quantitative data to determine the high school teachers' level of knowledge and skills in applying mathematics in real life. This study was a population study. All public high school teachers teaching Mathematics in Nueva Vizcaya that are employed in schools that offer academic track during the academic year 2015-2016 served as respondents. Only math teachers in schools that offer academic track were included because they are the future teachers of the senior high schools in mathematics. The Knowledge Test adopted from Calanta, et al. (2015) was used to measure teacher's

knowledge in mathematics while PISA Mathematics Test was used to measure teachers' skill in applying mathematics in real life. The Knowledge Test was composed of five items per domain in mathematics namely: 1) Numbers and Number Sense, 2) Geometry, 3) Patterns and Algebra, 4) Measurement, and 5) Statistics and Probability. The items were adapted from Callanta, et al. (2015) in their first edition of Mathematics Learner's Module, Department of Education instructional materials. The Cronbach reliability index was 0.62. The PISA mathematics test was composed of PISA released items involving mathematical content, mathematical processes, and situations. The test consists of real world problems of different levels that depend on the skills applied to solve the problem. The internal consistency index was 0.902. The Skills in applying mathematics in real life was composed of PISA 2012 released Mathematics items published in May 2013. In addition, the modified and adopted Pan-Canadian Assessment Program (PCAP) Questionnaire for teachers was used to determine the personal background, professional development, time management, assessment strategies, teaching strategies ,students' with special needs (the kinds of students teacher's teach), and attitudes of the teacher towards mathematics. These teacher-factors included in PCAP are very important in helping describe how mathematics is taught.

Descriptive statistics (i.e. frequency, mean, standard deviation) were used to describe the score of teachers. Independent Sample T-test / Mann-Whitney U test were used to find for significant difference in the scores when grouped by personal background particularly sex. Pearson-r and Spearman-rho were used to investigate or explore relationships of skills or knowledge in time management, assessment strategies, teaching strategies, students with special needs, and attitudes of the teacher towards mathematics.

Table 1 and 2 show the interpretation guides.

Table 1. ***Interpretation Guide for Level of Understanding***

Qualitative Description	% score
Poor Understanding	0.00 – 19.49 %
Fair Understanding	19.50 % - 39.49 %
Moderate Understanding	39.50 % - 59.49 %
Great Understanding	59.50 % - 79.49 %
Very Great Understanding	79.50 % - 100%

Table 2. ***Scoring Scale of Level of Skills of the Teachers in Applying Mathematics in Real Life***

Qualitative Description	Score
Below Level 1	0-21
Level 1	22-24
Level 2	25-27
Level 3	28-30
Level 4	31-33
Level 5	34-38
Level 6	Above 39

III. RESULTS AND DISCUSSION

Section 1. Teachers' Knowledge and Skills in Applying Mathematics in Real Life

Table 1a. Level of Teachers' Knowledge in Applying Mathematics in Real Life

Level	f	Percent
fair knowledge	4	17.4
moderate knowledge	10	43.5
great knowledge	9	39.1
Total	23	100.0

Overall: mean=52.17 (moderate understanding); SD=11.09

It can be learned from Table 1a that most of the teachers have moderate and above knowledge level. The result reveals that there were 4(17.4%) teachers with fair knowledge, 10(43.5%) teachers of moderate knowledge and 9(39.1%) teachers of great knowledge. This also indicates that most of the teachers have moderate knowledge. Furthermore, the result also reveals that overall, the teachers' knowledge in applying mathematics in real life was moderate.

The results are akin to the findings of Saldivar (2015) who studied the functional literacy of Chemistry teachers. Functional literacy is about applying or using one's knowledge in actual situations, which is applying in real life situations in the case of this study on mathematics. Saldivar's study revealed that the Chemistry

teachers' functional literacy level is approaching proficiency based on Department of Education's standards. Moreover, the study of Campo (2010) showed that the high school teachers are low in terms of content knowledgeability on exponential and logarithmic functions The mathematics teachers' low to moderate knowledge and understanding as well as the Chemistry teachers' below proficiency level indicate some semblance in the state of mathematics and science education at present.

Table 1b. Level of Teachers' Skills in Applying Mathematics in Real Life

Level of Teachers' Skills	Frequency	Percent
Below Level 1	22	95.7
level 6	1	4.3
Total	23	100.0

Overall: median= 14.03 (Level 1); SD=9.45

It can be gleaned from Table 1b that dominantly the teacher's skills can be described as below level 1. There were 22(95.7%) teachers with below level 1 skill in applying mathematics in real life and only 1(4.3%) teacher has level 6. This also indicates that almost all of the teachers' level of skill in applying mathematics in real life was level 1. It indicates that the teachers hardly impart applications of mathematics in real life.

These results can be explained by the fact that low knowledge of the teachers would naturally lead to low application. If one lacks the knowledge, utilization of the knowledge would be quite impossible. Thus low level of knowledge would mean low level of application.

Section 2. Teachers' Knowledge and Skills in Applying Mathematics in Real Life in Relation to other Teacher-factors

Table 2a and 2b shows the teachers' knowledge in applying mathematics in real life in relation to sex and the *mean ranks by group design and Mann-Whitney U test for knowledge and skills when grouped by sex* respectively.

Table 2a. Teachers' Knowledge in Applying Mathematics in Real Life in Relation to Sex

	Sex	N	Mean	Std. Deviation	Std. Error Mean	t	df	Sig. (2-tailed)
Knowledge	Male	9	14.000	1.4142	.4714	1.129	20	.272
	Female	13	12.692	3.2502	.9015			

*significant at 0.05 **significant at 0.01

Male teachers have higher mean score compared with females. However, t-test result reveals that there was no significant difference in the mean score of teachers' knowledge in applying mathematics in real life when grouped by sex. This means that the teachers' knowledge is the same regardless of sex. This further implies that teachers' knowledge and skills of male and female teachers are relatively the same.

Table 2b. The Mean Ranks by Group Design and Mann-Whitney U Test for Skills when Grouped by Sex

	Sex	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Exact Sig. [2*(1-tailed Sig.)]
Skills	Male	9	9.39	84.50	39.500	.209
	Female	13	12.96	168.50		
	Total	22				

*significant at 0.05 **significant at 0.01

Female teachers have higher mean scores compared with male teachers. Mann-Whitney U result shows that there was no significant difference between the teachers' skills in applying mathematics in real life when grouped by sex. The finding on skills supports the finding on knowledge which implies that the application of mathematics to real life situation is not affected by one's sex.

Tables 2c to 2h show the significant correlation between the teachers' knowledge or skill in applying mathematics in real life and selected teacher-related variables.

Table 2c. Correlation between Teachers' Knowledge or Skills and Teachers' Professional Development

Professional Development	**K (ρ)**	**S (ρ)**
Effect of participating mathematics professional development in teaching math	-.221	-.437*
Effect on mathematics teaching of taking part in professional development opportunities	-.459*	-.373

K= knowledge; S=skill *significant at 0.05 **significant at 0.01

Table 2c shows the significant correlation between the teachers' knowledge or skill in applying mathematics in real life and selected teacher-related variables particularly the professional development. There was no significant correlation between knowledge and effect of participating mathematics professional development in teaching math (r=-0.221). However, teachers' knowledge and skills are significantly but negatively related to effect on mathematics teaching of taking part in professional development opportunities (r =-.459, p <0.05) for knowledge, and r = -.437 at p<0.05 for skills). This finding contradicts the finding of Campo (2010) who found out that educational attainment and professional development have an influence on

the cognitive competence, particularly on reasoning skills of the mathematics teachers. This is rather alarming. It implies that the more exposed to professional development, the less knowledgeable and skillful the teachers are in real life applications of mathematics. The question that lingers now is, are the teachers' professional development activities related and relevant to applications of mathematics to real life? It is truly possible that teachers might be attending professional enhancements but in different areas not related to mathematics.

Table 2d. Correlation between Teachers' Knowledge or Skills and Teachers' Time Management

Time Management	**K (ρ/r[a])**	**S (ρ/r[a])**
Frequency in assigning different types of work	.299	.109
Frequency of doing activities related in monitoring assign homework	.245[a]	.176
Frequency of losing time because of misbehaviors, disruptions or unrelated discussions	.163 [a]	.203
Percentage spent in numbers and operations, geometry and measurement; patterns and relationships; and data management	.067 [a]	-.187

K= knowledge; S=skill *significant at 0.05 **significant at 0.01

Table 2d shows the significant correlation between the teachers' knowledge or skill in applying mathematics in real life and teachers' time management. The result also shows that there was no significant correlation between knowledge or skills and frequency in assigning different types of work, frequency of doing activities related in monitoring assign homework, frequency of losing time because of misbehaviors, disruptions or unrelated discussions, and percentage spent in numbers and operations, geometry and measurement; patterns and relationships; and data management.

Table 2e. Correlation between Teachers' Knowledge or Skills and Teachers' Assessment Practice

Assessment Practices	**K (ρ/r[a])**	**S (ρ/r[a])**
Frequency of Assessing students for final evaluation.	.300 [a]	.410
Frequency of using selected, short and/or extended response.	.007 [a]	-.002
Frequency of including recalling, applying, explaining and generalizing in teacher-developed mathematics test	-.014 [a]	-.137

K= knowledge; S=skill *significant at 0.05 **significant at 0.01

As gleaned in table 2e, there was no significant correlation between knowledge or skills and frequency of assessing students for final evaluation, frequency of using selected, short and/or extended response and frequency of including recalling, applying, explaining and generalizing in teacher-developed mathematics test.

Table 2f. Correlation between Teachers' Knowledge or Skills and Teachers' Teaching Strategies

Teaching Strategies	K (ρ/r[a])	S (ρ/r[a])
Extent of using instructional strategies in mathematics classes	.109 [a]	.278
Extent of using strategies like re-teaching, adapting instructions and resources; and providing enrichments	-.396 [a]	-.315
Extent to agree about learning mathematics and beliefs on students to learn math	-.159 [a]	.163
View on how valuable calculators, software, problem solving, discussion and manipulative in helping students	.306 [a]	.026
Percentage of the class time spent in teaching, small and group works, project and work stations and other activities in mathematics class	.607** [a]	.357
Frequency of explaining solutions orally, in writing, generalizations , reasoning and other related activities in math classes	.300 [a]	.410
Frequency of using resources in mathematics instruction	.171 [a]	.057

K= knowledge; S=skill *significant at 0.05 **significant at 0.01

In terms of teaching strategies, Table 2f shows that there was no significant correlation between knowledge or skills and extent of using instructional strategies in mathematics classes, extent of using strategies like re-teaching, adapting instructions and resources; and providing enrichments, extent to agree about learning mathematics and beliefs on students to learn math, view on how valuable calculators, software, problem solving, discussion and manipulative in helping students, frequency of explaining solutions orally, in writing, generalizations, reasoning and other related activities in math classes and frequency of using resources in mathematics instruction. There was a significant correlation between knowledge and percentage of the class time spent in teaching, small and group works, project and work stations and other activities in mathematics class but no significant correlation in skills.

Table 2g. Correlation between Teachers' Knowledge or Skills and Students with Special Needs

Students with Special Needs	K (ρ/r[a])	S (ρ/r[a])
Average number of students who needs accommodations or adoptions	-.255 [a]	-.020

K= knowledge; S=skill *significant at 0.05 **significant at 0.01

Table 2g shows the significant correlation between the teachers' knowledge or skill in applying mathematics in real life and selected teacher-related variables in terms of students with special needs. The result reveals that there was no significant correlation between knowledge or skills and average number of students who needs accommodations or adoptions.

Table 2h. Correlation between Teachers' Knowledge or Skills and Teachers' Attitudes towards Mathematics

Attitudes towards Mathematics	**K** **(ρ/r[a])**	**S** **(ρ/r[a])**
Extent to agree about positive thoughts about mathematics like enjoying it, easy, challenging and others.	.138 [a]	.074
Degree to agree how well students perform in mathematics based on their ability, good teaching and others	.166	.515*
Extent to agree that students struggle because of poor work habits, not enough ability, lack of support and others.	-.041 [a]	.233
Confidence of teacher in their ability in calculations, mental math, estimation, solving complex problems and technology.	.050	.201
Confidence of teacher in helping students develops understanding in numbers, geometry and measurements, pattern and statistics.	-.125	-.047
Extent of present challenges to ability to teach	.035	-.164

K= knowledge; S=skill *significant at 0.05 **significant at 0.01

As gleaned in Table 2h, there was no significant correlation in teachers' knowledge or skills in applying mathematics in real life and extent to agree about positive thoughts about mathematics like enjoying it, easy, challenging and others, confidence of teacher in their ability in calculations, mental math, estimation, solving complex problems and technology, confidence of teacher in helping students develop understanding in numbers, geometry and measurements, pattern and statistics, and extent of present challenges to ability to teach. There was no significant correlation between knowledge and degree to agree how well students perform in mathematics based on their ability, good teaching and others but there was significant correlation in teachers' skills in applying mathematics in real life.

In general, there was no significant correlation between teachers' knowledge or skills and assessment practices, time management and students with special needs. On the other hand, there was significant correlation between teachers' skills or knowledge and professional skills particularly in effect of participating mathematics professional development in teaching math and effect on mathematics teaching in taken part in professional development opportunities. Moreover, there was also significant correlation between teachers' knowledge and teaching strategies particularly in percentage of the class time spent in teaching, small and group works, project and work stations and other activities in mathematics class. Furthermore, there was also significant correlation between skills and attitudes particularly in degree to agree how well students perform in mathematics based on their ability, good teaching and others.

This indicates that the more time spent in teaching in mathematics class, the better the knowledge of the teacher. It also showed that the higher the perception on how students do well in mathematics because of ability, habits, teaching, friends and effort, the better skills the teacher have. However, the lower the effect on

the participation in mathematics development activities, the better the result of the knowledge of the teachers and the lower the effect of participation in mathematics professional development in teaching mathematics, the better result of the skills of teachers.

Section 3. Significant Correlation between Teachers' Knowledge and Skills in Applying Mathematics in Real Life

Table 3. Correlation between Teachers' Knowledge and Skills in Applying Mathematics in Real Life

	Skills (ρ/r^a)
Knowledge	.267

*significant at 0.05 **significant at 0.01

As revealed in Table 3, there was no significant correlation between the teachers' skills and knowledge in applying mathematics in real life. This means that the higher or lower level of knowledge of teacher in mathematics is not an assurance of more competence or less competence of the teacher in applying mathematics in real life.

IV. CONCLUSION

1. The teachers' moderate knowledge and below level 1 skill in applying mathematics implies a need for retooling to help them cope with the demands of teaching in the senior high school.
2. The professional development activities of the teachers seem; not to influence their knowledge and skills in applying mathematics to real life situations. On the other hand, the more time they spend in activities in mathematics class, and the more positive they are towards mathematics; the higher is their knowledge and skills in mathematics. It appears that these activities generate more knowledge and skills not only for the students but more importantly, to the teachers.
3. Application of mathematics to real life still, which is a goal in K to 12 curriculum seems wanting among mathematics teachers, particularly the prospective senior high school teachers.

The results of the study revealed that the mathematics teachers are not yet prepared for the senior high school curriculum. This indicates that the trainings attended by the teachers in preparation for grade 11 and 12 of K to 12 curriculum are not enough. The negative correlation on professional development should be looked into because the teachers might be attending seminars and trainings that are not related to what they really need in the classroom. There is a need for more relevant trainings for teachers to help them cope with the demands and challenges of K to 12 curriculum.

ACKNOWLEDGEMENTS

Special thanks to the administration of Saint Mary's University through the University Research Center (URC) for the research assistance which helped a lot in realizing the study.

REFERENCES

Bokar, J. (2013). Solving and reflecting on real-world problems: Their influences on mathematical literacy and engagement in the eight mathematical practices (Unpublished Thesis). Retrieved from https://www.ohio.edu/education/academic-programs/upload/Anothony-Bokar-Master-Research-Thesis-3-copy.pdf

K to 12 Tootlkit. Philippine Copyright 2012. Retrieved from http://issuu.com/deped.philippines/docs/k_to_12_toolkit

Department of Education (2012). Policy guidelines on the implementation of grades 1 to 10 of the K to 12 Basic Education Curriculum (BEC) effective school year 2013-2013. Retrieved from http://www.deped.gov.ph/sites/default/files/order/2012/DO_s2012_31.pdf

Felton, M. (2014).Mathematics and the real world. http://www.nctm.org/Publications/Mathematics-Teaching-in-Middle-School/Blog/Mathematics-and-the-Real-World/

Marban, J. M. (2009). Professional competencies of mathematics teachers: an international perspective. Retrieved from http://library.iated.org/view/MARBAN2009PRO

Braza, M. and Supapo, S. (2014). Effective solutions in the implementation of the K to12 mathematics curriculum. SAINSAB.ISSN 1511 5267.Vol. 17, 2014, pp 12-11

Callanta, M., Canonigo, C., Chua, A., Cruz, J.,Esparrago, M.,et al. (2015). Mathematics Grade 10 Learner's Module. Department of Education. Philippines: REX Book Store

Council of Ministers of Education, Canada (2010). Pan-Canadian Assessment Program: Teacher Questionnaire. Retrieved from http://www.cmec.ca/docs/pcap/pcap2010/English/4_Questionnaire_EN/pcap-teacher-questionnaire.pdf

Saldivar, C. (2015) Functional literacy in Chemistry of grade-9 students and science teachers under the K-12 curriculum program (Unpublished thesis). Saint Mary's University, Bayombong, Nueva Vizcaya

Campo, C. M. (2010). Pedagogical content knowledge in exponents and logarithms of high school mathematics teachers in the Catholic schools of the Diocese of San Jose (Unpublished thesis). Saint Mary's University, Bayombong, Nueva Vizcaya.