Mathematics college readiness of grade 12 students: Basis for instructional enhancement

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Abstract *–Mathematics requires critical thinking and problem solving skills which are indispensable in gauging college readiness of entering tertiary students. This quantitative research determined the Mathematics College Readiness (MCR) of 2186 grade 12 students across all career tracks and learning strands from nine (9) secondary schools in Cagayan province, Philippines. MCR was measured through a validated criterion-referenced test which was based on the College Readiness Standards (CRS) of the Commission on Higher Education (CHED). Reasons for students' non-readiness as perceived by 73 mathematics teachers were also investigated using a survey questionnaire and interview. Frequency count, percentage distribution, mean, independent sample t-test, Analysis of Variance, and thematic analysis were utilized to interpret the gathered data. Findings revealed that majority of the students are not ready to take college-level mathematics courses. Students who have more mathematics exposures in high school are significantly more ready for college mathematics compared to those who just comply with the minimum mathematics subject requirements. The teachers' perceived reasons of students' non-readiness for college mathematics are students' negative attitude, anxiety, and weak foundation in basic mathematics, heavy teaching workloads and limited professional growth of teachers, inadequate and poor quality of learning materials and facilities, disruptions of classes, lack of parents' involvement in the education of their children, disadvantages of spiral progression and the "No Child Left Behind Act", and numerous competencies in the mathematics curriculum. Instructional enhancement along content, innovative teaching strategies, authentic assessment and interactive instructional materials are necessary to address students' non-readiness of college mathematics.*

Keywords *–College readiness standards, grade 12 students, instructional enhancement, mathematics college readiness, reasons for students' non-readiness of college math*

INTRODUCTION

The quality of education in the Philippines has not been steadily commendable for the past decades due to the deterioration in the performances of Filipino students in international assessments such as in Programme for International Student Assessment (PISA) and Trends in International Mathematics and Science Study (TIMSS). In the 2003 TIMSS result, scores of 4th grade and 8th grade Filipino students in science and mathematics are below the international averages. Similarly, in 2008, the participating science high schools ranked lowest in the category of advanced mathematics [1]. The latest result of 2018 PISA is also alarming since the country ranked lowest in reading comprehension and second-lowest in mathematics out of the 79 participating countries [2].

The Philippine government is unceasingly doing its best to better the quality of education the country offers to Filipino students. One of the reforms in education is Republic Act No. 10533, officially cited as the Enhanced Basic Education Act of 2013, has been implemented to make the Philippine education abreast with the trends in education and eventually produce graduates who are college and livelihood ready. Producing senior high school graduates who are college-ready is one of the goals of the K to 12 program in the Philippines [3]. This is an entwined mission of the Department of Education (DepEd) and Commission on Higher Education (CHED).

Under the Curriculum Development (Section 5 of RA 10533), DepEd is required to coordinate with CHED in guaranteeing college readiness and avoiding duplication of subjects and remedial in basic education. The law also ordered that DepEd and CHED shall formulate synchronized basic and tertiary education. Moreover, under the heading Transitory Provisions (Section 12 of RA 10533), DepEd and CHED shall formulate the mechanisms and proper strategies needed to have suave transition from the 10-year basic education cycle to the K to 12 cycle and one strategy

done is the linking of K to 12 competencies to the new tertiary curricula.

Thus, crafting a college readiness framework is necessary for Higher Education Institutions (HEIs) to share their expectations among Basic Education Units (BEUs) [4]. With these mandates, CHED's Technical Panel on General Education (TPGE) crafted the College Readiness Standards (CRS) covering the core subjects such as Science, Social Studies, Mathematics, Humanities, Literature, Filipino, and English. These standards were approved by the commission en banc through CHED Resolution No. 298-2011 [5].

On the other hand, one of the features of the K to 12 Program is the additional two years for senior high school (SHS) [6]. Students have four options of career tracks to pursue in SHS. These are Academic, Arts and Design, Technical Vocational Livelihood (TVL), and Sports. Academic track has four learning strands namely: Accountancy, Business and Management (ABM), General Academic Strand (GAS), Humanities and Social Sciences (HUMSS), and Science, Technology, Engineering and Mathematics (STEM).

In this context, college readiness may be ensured if there is an alignment on the students' career track or learning strand to their course in college. On the contrary, CHED released a policy on the eligibility of graduates of the K to 12 program to enter tertiary education regardless of career track and learning strand in SHS [7]. In other words, career track and learning strand of college enrollees will not be considered as an entry requirement to HEIs. This is one of the perceived gray areas on the implementation of the K to 12 program of DepEd and ruling of CHED for HEIs. Nevertheless, HEIs may exercise their academic freedom in accepting enrollees through other admission requirements such as college admission test and interviews. Hence, college readiness of the enrollees is necessary to establish before admission in tertiary education. Along this vein, HEIs are in quest to develop mechanisms and tools that measure college readiness of entering tertiary students [8].

Research studies pointed out the significant role of mathematics proficiency as one of the measures to determine college readiness [9]-[10]. Subsequently, under preparedness for college mathematics is considered as the greatest obstacle in accomplishing a college degree [11]-[12]. There were also reports that students who are ready for college-level mathematics are more likely to enroll in college, earn better grades, and finish their college degree [13]. So, HEIs across the globe determine readiness for college mathematics as one of the crucial requirements in the admission of entering college students [14]-[15]. Due to the recognized significance of mathematics in college readiness, HEIs, particularly in the United States of America, have policy on admission of college enrollees proven to be not college ready. Students are required to take developmental mathematics or remedial before allowing them to enroll in a credit-bearing college level classes [16]-[18]. Mathematics requires critical thinking and problem solving skills [19] which are indispensable in gauging college readiness of entering tertiary students.

In this light, there is a need to appraise students' readiness for college mathematics, more importantly when they enter the tertiary ladder of their education. With the new educational reform in the Philippines, it is expected that the target competencies defined in the Basic Education Curriculum were attained by K to 12 graduates. Moreover, considering their varied instructional exposures, it is expected that they have acquired varied levels of competencies. Determining students' readiness for college mathematics is necessary in bridging the gap of mathematics instruction between BEUs and HEIs; thus, this study came into conception.

OBJECTIVES OF THE STUDY

This study determined the Mathematics College Readiness (MCR) of grade 12 students in Cagayan province, Philippines which served as a basis for instructional enhancement. The specific objectives of the study are: (1) determine the MCR of the grade 12 students as a whole and in terms of specific content areas, (2) compare the students' MCR when grouped according to profile variables such as nature of curriculum in junior high school (JHS) (Science and Academic), learning strand (ABM, STEM, GAS, and HUMSS) and career track (Academic, Arts and Design, Sports, and TVL), (3) determine the reasons for the students' non-readiness of college mathematics as perceived by their mathematics teachers, and (4) propose an instructional enhancement to address students' non-readiness of college mathematics.

Theoretical Underpinning

This study is anchoredon one of the three *'Laws of Learning'*developed by Edward L. Thorndike which is the 'Law of Readiness', also known as the 'Law of Action Tendency'. This law means that leaners learn best when they possess the requisite knowledge and skill. Reasonably, teachers teach new concepts and skills based on students' prior knowledge [20].

More specifically, the study is anchored on Conley's [21] framework of college readiness where it is defined as "the level of preparation a student needs in order to enroll and succeed-without remediation-in a credit-bearing general education course at a postsecondary institution that offers a baccalaureate degree". Applying Conley's definition of college readiness in this study, "mathematics college readiness is the student's ability to be successful in college-level mathematics courses without the need for remedial or developmental coursework" [13].

In this context, gauging readiness of entering tertiary students for college mathematics is important for HEI faculty to have bases in teaching higher mathematics concepts as teachers' instruction must commence on what students already know.

METHODS

Research Design

This study is a quantitative research that utilized a descriptive–comparative design. The study focused its investigation on the readiness of grade 12 students for college-level mathematics. The students' readiness was compared when grouped according to nature of curriculum in JHS and learning strand and career track in SHS. The teachers' perceived reasons behind non-readiness of students on college mathematics were also determined.

Respondents

The respondents of the study were grade 12 students for School Year 2018-2019 from nine (9) secondary schools in Cagayan Province. Six (6) of which are public schools and three (3) are private schools. These schools were determined by the Admissions Office of Cagayan State University classified as its feeder schools. The number of respondents in each school was determined through Slovin's formula. In determining the number of respondents in each career track and learning strand, stratified random sampling and proportionate allocation were employed. Class sections (strata) were identified through lottery method. Out of 5211 grade 12 students enrolled in the nine (9) schools, 2186 (41.95%) students constituted the sample size. Moreover, 73 JHS and SHS mathematics teachers participated in determining the reasons for the non-readiness of the grade 12 students on college mathematics. The profile of the grade 12 students is shown in Table 1.

Table 1. Profile of the student-respondents

Grouping Variable	Specific Profile		F	%
Nature of curriculum (JHS)	Science		210	9.61
	Academic		1976	90.39
	Total		2186	100.00
Career Track and Learning Strand enrolled (SHS)	Academic	ABM	361	16.51
		GAS	327	14.96
		HUMSS	427	19.53
		STEM	499	22.83
		Total	1614	73.83
	Arts and Design		29	1.33
	Sports		35	1.60
	TVL		508	23.24
	Total		2186	100.00

Research Instruments

The main instrument utilized is the MCR Test which was based on the College Readiness Standards (CRS) constructed by the TPGE of CHED and was approved by the commission en banc. The development and validation of the instrument had undergone six (6) stages namely: (1) planning of the test, (2) conducting content validation from experts, (3) revising the draft based on the results of Content Validity Index and comments of experts, (4) administering the try-out test, (5) conducting item analysis and computing the reliability coefficient, and (6) revising the test based on the item analysis and finalizing the test.

Planning of the test included the alignment of the competencies set in the CRS of CHED and K to 12 Curriculum Guide in Mathematics. Test objectives were developed based on the aligned competencies. After constructing the test objectives, the table of specification was developed. After which, a 100-item multiple choice test was constructed as first draft. Conducting content validation was done by six (6) mathematics experts (3 SHS master teachers and 3 College professors). They validated the tool by rating the relevance of the items of the test on a scale of 1 to 4, 1 as least relevant and 4 as very relevant. The results of the content validity index and suggestions of the experts were used to refine the items. The computed S-CVI (content validity of the overall scale) is 0.944 which is an acceptable content validity index [22]. Moreover, 27 items were revised as suggested by the content validators.

The try-out test was then administered among 100 grade 12 students from three (3) secondary schools in Tuguegarao City, Cagayan. Item analysis was used to evaluate the test. Only the upper 27% and lower 27% of

the examinees were considered. The indices of discrimination and difficulty per item were established, and these served as bases in retaining, discarding, and revising items. These indices were evaluated and interpreted using Hopkins and Stanley's [23] characteristics of a good item. Based on the result of the item analysis, 63 good items were retained. Moreover, 2 items with a difficulty index of moderately difficult and discrimination index of low were refined to complete the 65 items of the MCR Test. The number of items in each content area is as follows: Algebra- 17, Geometry- 13, Statistics and Probability- 16, Trigonometry- 5, Pre-Calculus- 5, and Calculus- 9. The Kuder-Richardson 21 was used in establishing the internal consistency of the developed MCR Test. The computed reliability coefficient is 0.938. Such value signifies excellent reliability [24].

Furthermore, a survey questionnaire was constructed to determine the reasons for students' non-readiness of college mathematics. This was content validated by three (3) Graduate School professors teaching Research courses in Cagayan State University. The questionnaire was accomplished by the JHS and SHS mathematics teachers of the school respondents.

Research Procedure

Foremost, letters were forwarded to the Schools Division Superintendents, University and School Presidents, Principals and SHS Coordinators of the nine (9) school respondents to request permission for the conduct of the study. Upon approval, the Principals or SHS Coordinators set schedules on the administration of the MCR Test. Principals and SHS coordinators assigned teachers to proctor the test. The test was administered among grade 12 students in the months of February and March 2019, one to two months before the students' graduation. Proctors were given guidelines in administering the test. The researcher monitored the proctors while administering the test. Data gathered from the MCR Test were tabulated and analyzed. Results of the test were handed to the JHS and SHS mathematics teachers of the grade 12 students. Attached to the result is a survey questionnaire which aims to determine the reasons behind the students' non-readiness of college mathematics. Unstructured interview was conducted to validate the teachers' responses on the survey questionnaire. Data gathered from the MCR test, survey questionnaire and unstructured interview were consolidated, tabulated, treated statistically, and analyzed.

Data analysis

Descriptive statistics such as frequency count, percentage, and mean percentage score (MPS) were used to describe the MCR of the students. The students' readiness was interpreted based on the guideline utilized by Hererra and Dio [25] which was patterned on the seven – descriptive equivalent of Achievement Level of the National Education Testing and Research Center (NETRC).

MPS	Descriptors	Remarks
0% - 4%	Absolute No Mastery	Not Ready
5% - 15%	Very Low Mastery	Not Ready
16% - 34%	Low Mastery	Not Ready
35% - 65%	Average Mastery	Moderately Ready
66% - 85%	Moving Towards Mastery	Moderately Ready
86% - 95%	Closely Approximating Mastery	Ready
96% - 100%	Mastered	Ready

Inferential statistics such as independent sample t-test was employed to compare the students' MCR when grouped according to nature of curriculum in JHS where Analysis of Variance (ANOVA) was utilized to compare the readiness when grouped according to career track and learning strand. Mean and thematic analysis were used to interpret the perceived reasons of JHS and SHS teachers for the students' non-readiness of college mathematics. Computed means were categorized along the following descriptive values: 1.00-1.74 (Strongly disagree), 1.75-2.49 (Disagree), 2.50-3.24 (Agree), and 3.25-4.00 (Strongly agree).

Ethical Considerations

The purpose, merits, and manner of conducting the study were explained to the Schools Division Superintendents of Cagayan and Tuguegarao City and principals, SHS coordinators, and mathematics teachers of the school respondents. Most importantly, the confidentiality of respondents' record, responses, and test scores was assured.

RESULTS AND DISCUSSION

Figure 1 presents the MCR of the students as a whole and it reveals that majority (f=1474, p=67.43%) are not ready to take college-level mathematics courses. Hence, 710 (32.48%) respondents are moderately ready and only 2 (0.09%) respondents are actually ready.

It is alarming to note that majority of the students are not ready to take college-level mathematics courses. This finding concurs to the report of DepEd on the 2018 PISA [26] where Philippines ranked 78th (second-lowest) in mathematics out of the 79 participating countries. Under preparedness for college mathematics has been a persistent problem also in many states in America [12], [27] and high percentage of SHS graduates are subjected for remedial and developmental mathematics [16]-[18].

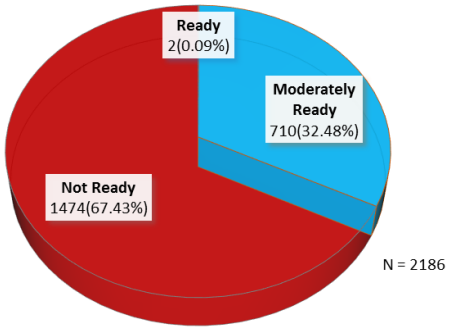

Figure 1. Mathematics college readiness of the students as a whole

It could be gleaned in Table 2 that students have average mastery and moderate readiness on Algebra, Geometry, and Pre-Calculus. On the other hand, students are not ready and have low mastery on Statistics and Probability, Trigonometry, and Calculus.

Table 2. Mathematics college readiness of the students in terms of specific content areas

Content Area	MPS	Descriptors	Remarks
Algebra	36.59	Average Mastery	Moderately ready
Geometry	37.13	Average Mastery	Moderately ready
Statistics and Probability	27.11	Low Mastery	Not ready
Trigonometry	26.08	Low Mastery	Not ready
Pre-Calculus	39.76	Average Mastery	Moderately ready
Calculus	30.24	Low Mastery	Not Ready
Overall	32.82	Low Mastery	Not Ready

Despite students' instructional exposure to Statistics and Probability from JHS to SHS, they still show poor performance in the subject. Meanwhile, low result in Trigonometry can be associated to the subject offering of DepEd. Unlike in the Revised Basic Education Curriculum (RBEC), Trigonometry is a separate subject taken during fourth year high school while in the new K to 12 mathematics curriculum, only STEM students take Trigonometry and it is even congested in the subject Pre-Calculus along with Analytic Geometry and Series and Mathematical Induction. Poor performance in Calculus can be associated to the congestion of content topics in Basic Calculus from were Differential and Integral Calculus were merged. It should be noted that these subjects are stand-alone subjects in tertiary education because these are considered high-level mathematics courses.

In general, students are not ready to take college-level mathematics. This finding implies that students will likely show poor performance in college mathematics since they did not master the prerequisite competencies as posited by Thorndike's Law of Readiness. Considering college professors' perspective in 48 states in America, they associated non-readiness to students' poor mathematical ability on the fundamental topics needed for college mathematics such as algebra, functions, statistics and probability, geometry, reasoning, and generalization [28].

Table 3. Comparison of students' mathematics college readiness when grouped according to profile variables

Grouping Variables	Specific Profile	MPS	SD	C-value	P-value
Nature of curriculum (JHS)	Science Academic	43.53 31.15	15.16 11.07	t = 11.51	0.000**
Academic Learning Strand	ABM GAS HUMSS STEM	37.81 29.15 29.27 39.65	12.83 9.25 8.56 14.84	F = 89.88	0.000**
Career Track	Academic Arts and Design Sports TVL	34.37 27.65 27.34 26.53	12.85 5.20 6.74 7.08	F = 62.59	0.000**

***significant at the 0.01 level*
C-value – Computed value, P-value – Probability value

As shown in Table 3, significant differences were unveiled on the students' MCR when grouped according to nature of curriculum in JHS, learning strand, and career track.

Graduates of science curriculum in JHS are significantly more ready compared to those graduates of academic curriculum. This can be attributed to the disparity of mathematics subjects offered in each curriculum where students enrolled in science high schools took more and higher level mathematics courses in JHS. On the other hand, those who enrolled in high

schools under the academic curriculum just took the minimum subject offering as prescribed by DepEd. This finding is consistent with the assertion of Long, Iatarola, and Conger [29] that students who completed more mathematics subjects in high school are more prepared for college-level mathematics than those who just completed the minimum mathematics subject requirements.

Further analysis using post hoc test reveals that students from ABM and STEM strands are significantly more ready for college mathematics than those enrolled in the GAS and HUMSS strands. The difference among learning strands may be attributed to their academic preparation in mathematics. Students enrolled in STEM and ABM strands have math-related specializedsubjects up to their grade 12 level. For instance, students enrolled in STEM strand take Pre-Calculus, Calculus, and Physics 1 and 2 while those in ABM strand have Business Mathematics, Accounting, and Finance. Zelkowski [30] found outthat students who were continuously enrolled in mathematics courses in their senior years were college-ready. This finding suggests that students who were constantly exposed to mathematics courses in high school like those students enrolled in ABM and STEM strands will be likely more college-ready in mathematics.

Students enrolled in Academic track are significantly more ready for college mathematics than those enrolled in Arts and Design, Sports, and TVL tracks. The result can be attributed to the students' mathematics instructional exposure in each track. Arts and Design, Sports and TVL tracks have lesser exposure to mathematics courses as compared to those in the Academic tracks especially students enrolled in STEM and ABM strands. This corroborates the findings of Kowski [31] that taking mathematics classes beyond what is required lessens the probability of undergoing remedial classes.

It can be clinched that strong academic preparation, sufficient mathematics subject offerings, and greater instructional exposure of students to mathematics ensure readiness for college-level mathematics courses. This substantiates the claim of Zelkowski [32] and Cogan, Schmidt, & Guo [33] that continuous and rigorous exposure to high school mathematics results in higher mathematics achievement and increases the odds of completing a college degree.

Table 4 presents the perceived reasons of JHS and SHS mathematics teachers on the students' non-readiness of college mathematics. Teachers' reasons are presented in five (5) categories namely; student, teacher, learning environment, parents, and educational system.

Table 4. Perceived reasons of JHS and SHS teachers on students' non-readiness of college mathematics

Reasons	Mean	Descriptive Value
Students		
Negative attitude towards mathematics	3.53	Strongly Agree
Anxiety and fear towards mathematics	3.38	Strongly Agree
Weak foundation of students in basic mathematics	3.64	Strongly Agree
Teachers		
Lack of teachers in mathematics	2.16	Disagree
Various preparations handled by a math teacher	2.60	Agree
Teachers' lack of educational preparation	2.30	Disagree
Teachers not sent to seminars and trainings regarding the latest trends in mathematics teaching	2.78	Agree
Lack of mentoring practices among the mathematics teachers	2.56	Agree
Teachers' failure to address the least mastered mathematics competencies	2.48	Disagree
Learning Environment		
Inadequate instructional materials in mathematics	3.19	Agree
Overcrowded or large classroom size	3.25	Agree
Inadequate facilities like libraries and mathematics laboratories	3.25	Agree
Poor quality of textbooks/modules/workbooks	3.18	Agree
Inadequate textbooks/modules/workbooks	3.38	Strongly Agree
Disturbances of classes due to co-curricular activities	3.23	Agree
Disturbances of classes due to extra-curricular activities	3.22	Agree
Disturbances of classes due to calamities and holidays	3.15	Agree
Parents		
Lack of parental involvement in the education of their children	3.32	Strongly Agree
Lack of parents' motivation/inspiration provided to children to boost their confidence	3.26	Strongly Agree
Parents' failure to follow-up on the instructional concerns of their children	3.38	Strongly Agree

Table 4. (cont) Perceived reasons of JHS and SHS teachers on students' non-readiness of college mathematics

Reasons	Mean	Descriptive Value
Educational System		
Spiral progression (There is no focus on one subject in a school year for Grade 7 to Grade 10)	3.11	Agree
Misconception of the No Child Left Behind Act (Automatic promotion of students)	3.23	Agree
Numerous mathematics competencies set by DepEd at the expense of meaningful learning of mathematics concepts	3.14	Agree

A. Student

Teachers expressed strong agreement that students' non-readiness of college mathematics may be attributed to their weak foundation of basic mathematics concepts, and negative attitude and anxiety towards mathematics. Anxiety and negative attitude towards mathematics as causes of students' poor performance in mathematics are persistent problems in mathematics education. Research studies revealed that students' mathematics performance has significant negative correlation with their anxiety to the subject [34]-[36]. This means that students who have high anxiety tended to perform poorer in mathematics. Mata, Monteiro, and Peixoto [37] found out that good achievers in mathematics develop more positive attitudes than lower achievers. This suggests that students' success in a math task promotes more positive attitudes and increases their sense of competence. This also implies that curricula which promote positive attitudes toward mathematics rather than content alone can facilitate mathematics efficiency.

B. Teacher

Interestingly, teachers also agreed on some of the factors where they are involved. Various preparations handled by mathematics teachers was determined as reason for students' non-readiness of college mathematics. There are teachers who are handling both JHS and SHS classes making them handle as many as 4 to 5 preparations in a semester or school year. Likewise, teachers' limited opportunities for professional growth such as seminars and trainings about the latest trends in mathematics teaching was considered as factor. Another reason identified is the lack of mentoring practices among themselves. They do not mentor each other because of personal reasons, lack of time and too many responsibilities and concerns. However, they see the potential of mentoring each other to improve students' mathematics performance because of the existence of spiral progression. They realize the domino effect if students did not master the basic concepts in mathematics in the lower year levels.

C. Learning Environment

Inadequacy of instructional materials and facilities and poor quality and insufficiency of mathematics textbooks, modules, and workbooks are considered reasons for students' non-readiness of college mathematics. This supports the findings of Mbugua, Kibet, Muthaa, and Nkonke [38] that inadequacy of teaching and learning materials is a factor contributing to poor mathematics performance. Moreover, overcrowded classrooms or large class sizes are also considered as a factor. This finding affirms the study of Sa'ad, Adamu, and Sadiq [39] which identified overcrowded classes as one of the causes of students' poor mathematics performance. Disturbances of classes due to co-curricular, extra-curricular, and calamities and holidays were also stressed by teachers as major reasons in not teaching some of the competencies especially those set in the last chapter. Some topics are not really discussed because of lack of time due to various disturbances of classes. Mji and Magkato [40] and Gitaari, Nyaga, Muthaa, and Reche [41] identified non-completion of the syllabus in a year as a significant factor leading to poor mathematics performance.

D. Parents

Teachers also expressed a strong extent of agreement that students' non-readiness of college mathematics may be attributed to parents' lack of parental involvement in the education of their children, lack of motivation or inspiration provided to children to boost their confidence, and their failure to follow-up on the instructional concerns of their children. The result supports the findings of Jameela and Alib [42] that students who do not get enough support from their guardians when they are doing homework is one of the causes of poor mathematics performance. They also posited that community values and home background can make effective learning that leads towards high mathematics achievement.

E. Educational System

The spiral progression of the K to 12 program is pointed out as one of the reasons for the students' non-readiness of college mathematics. Teachers' dilemma in

the spiral progression is that students have low retention that is why teachers end up reviewing topics that should have been mastered in the previous school years. This is necessary to do so that students will understand the present topic. However, with this practice, not all topics are covered for the school year. Furthermore, the misconception of the "No Child Left Behind Act" which teachersdefine as automatic promotion or mass promotion of students was identified as reason for students' non-readiness. One of the reasons why the Philippines shifted to K to 12 program is that there are too many non-practical subjects [43]; however, teachers still perceived that there are still numerous mathematics competencies set by DepEd at the expense of meaningful learning of mathematics concepts.

Proposed instructional enhancement plan to address the students' non-readiness of college mathematics

Based on the findings particularly the result of the MCR Test and the teachers' perceived reasons behind the students' non-readiness of college mathematics, a concept paper for Content and Methodology Training as instructional enhancement is crafted.

The project is titled "Ensuring Mathematics College Readiness among SHS Graduates of the Top Feeder Schools of Cagayan State University: A CSU Extension Project" with four training components which will focus on mathematics content enrichment, developing students' positive attitude towards mathematics through innovative teaching strategies, enhancing student-centered learning through authentic assessment in mathematics and module writing in mathematics.

The general objectives of the extension project are the following: (1) Conduct series of seminars, lectures, trainings, and workshops on the identified topics among JHS and SHS teachers which are deemed essential in enhancing mathematics competencies, (2) Conduct trainings and workshops on the pedagogical aspects of the different identified topics, and (3) Train teachers in constructing their own instructional materials which facilitate better teaching-learning process in mathematics. Furthermore, the specific objectives of the project are the following: (1) Articulate deep and broad understanding of the mathematics competencies set in the College Readiness Standards (CRS) needed by students to become mathematics college ready, (2) Integrate the different constructivist teaching approaches in mathematics instruction that can bolster students' interest in acquiring mathematics competencies, (3) Construct and utilize the different forms of authentic assessment in mathematics instruction so that meaningful and realistic learning in mathematics among students will be realized, and (4) Design modules in the different content areas in mathematics that contain instructional activities which will facilitate teaching-learning process. Other parts included in the concept paper are rationale, paradigm and components of the project, implementation plan, specific plan of activities, budgetary requirements, and sustainability plan. This extension project will undergo critiquing among technical experts and will be proposed to the Research Development and Extension Unit of Cagayan State University for approval.

CONCLUSION AND RECOMMENDATION

Generally, the study reveals that the grade 12 students involved in the study are not ready to take college-level mathematics courses. This is an indicator that they did not master the basic mathematics competencies as defined in the junior and senior high school curriculum and etched in the College Readiness Standards of CHED which are prerequisites to understand higher level mathematics in college. Remarkably, students who are products of science curriculum in JHS and those enrolled in ABM and STEM strands in SHS were significantly more ready for college mathematics compared to their grouping counterparts. This is an implication that rigorous academic preparation and more instructional exposures to high school mathematics guarantee readiness for college mathematics. Thorndike's law of readiness supports the findings of the study since students' MCR is dependent on their foundation of high school mathematics.

Identified reasons of students' non-readiness for college mathematics as perceived by their mathematics teachers in JHS and SHS are students' negative attitude, anxiety, and weak foundation in basic mathematics, heavy teaching workloads and limited professional growth of teachers, inadequate and poor quality of learning materials and facilities, disruptions of classes, lack of parents' involvement in the education of their children, disadvantages of spiral progression and the "No Child Left Behind Act", and numerous competencies in the mathematics curriculum. Instructional enhancement along content, innovative teaching strategies, authentic assessment, and interactive instructional materials in mathematics are necessary to address students' non-readiness of college mathematics.

The study, though, has some limitations. Score in a single test may not be adequate to determine the overall

readiness of students for college mathematics. Thus, it is recommended for future researchers to conduct comprehensive analysis and alignment of mathematics competencies in BEUs and HEIs. The perspective of the HEI teachers with regard the students' readiness for college mathematics should also be explored since they have the direct involvement on this matter. Other factors affecting college readiness through a qualitative study may be conducted to have a better generalizability of findings.

On a practical, significant note, findings of the study yield necessary implication on the need of bridging the gap of mathematics instruction between BEUs and HEIs.The study also raised awareness on teachers' perceived problems in mathematics education which are deemed necessary to address.

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