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Predictive Validity of Entry Level Mathematics on Mathematical Knowledge for Teaching Basic school Mathematics of Pre-service Teachers in Ghana

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Abstract

Introduction: Knowledge about teaching mathematics remains a contentious issue in the preparation of pre-service teachers in Ghana. This study explored relationships among entry-level mathematical knowledge (ELMK), mathematics content knowledge (MCK) and mathematics pedagogical content knowledge (MPCK) scores of pre-service teachers in colleges of education (CoEs) in Ghana.

Methods: The cross-sectional survey design was adopted for this study. A total of 998 pre-service teachers from ten (10) public colleges of education were sampled via multi-stage sampling technique. Structured questionnaire and unstructured observation schedule were used for the survey. College mathematics test results were used as secondary data. The data were analysed using descriptive statistics (frequency count, percentage) and inferential statistics (Pearson's correlation, paired-samples t-test and *regression analysis) with the aid of Statistical Package for Social Sciences software version 22.*

Results: The majority of pre-service teachers in Ghanaian colleges of education had average but relatively weak grades in ELMCK. ELMCK did not significantly predict pre-service teachers' MCK statistically ($p \geq 0.05$) although a statistically significant positive correlation existed between the variables. Although a negative correlation existed between ELMCK and PMCK, ELMCK significantly predicted pre-service teachers' PMCK statistically ($p \leq 0.05$) but the effect size was statistically negligible.

Conclusions: This study concluded that, CoEs in Ghana admit pre-service teachers with average but weak grades in ELMK. Therefore, Ghanaian CoEs should structure and introduce PMCK alongside MCK for pre-service teachers. Mathematics tutors in CoEs should organize remedial lessons for pre-service teachers to scale-up their MCK and PMCK that adequately equip them with MKT.

Keywords: *Entry-level mathematical knowledge (ELMK), mathematics content knowledge (MCK), mathematics pedagogical content knowledge (MPCK), mathematical knowledge for teaching (MKT), pre-service teachers.*

Introduction

Individuals who enroll into Colleges of Education (CoE) in Ghana are known as pre-service teachers or teacher trainees. It is worth noting that one of the major requirements for selection into a CoE in Ghana is the entry level performance grade in the West Africa Senior Secondary Certificate Examination (WASSCE) [1], particularly credit passes or better in Core Mathematics, English Language and Integrated Science. This background attribute or entry level behaviour, with a particular reference to entry level mathematics knowledge (ELMK) shapes the thinking and practices of pre-service teachers' mathematics content knowledge (MCK) and mathematics pedagogical content knowledge (MPCK) while in college. Mathematics achievement entry grade is very critical in assessing pre-service teachers before entry into CoE as reported in Teacher Education (TE) and Development Study in Mathematics (TEDS-M) [2]. This is because it is assumed that entry behavior in mathematics is prognostic of future mathematics performance. Therefore, this study hypothesizes that entry-level mathematical knowledge (ELMK), predicts MCK and MPCK of pre-service teachers which eventually impact on their mathematical knowledge for teaching mathematics (MKT) after college.

The mathematical knowledge for teaching mathematics (MKT) has been of interest to

teacher educators of pre-service teacher education and training in Ghana. Mathematical knowledge for teaching is understanding of the mathematical horizon and it is evident when the teacher demonstrates a broad understanding of how mathematical ideas connect. A teacher who demonstrates knowledge of the mathematical horizon has peripheral vision, for example, they know the questions to prompt students' understanding of mathematical proofs, know when to assist learning as well as when to be patient in allowing the student to work through the problem independently. Studies aimed at teachers' mathematical knowledge mainly have focused on two topics: first, the teachers' characteristics, for example, the number of mathematics courses they have completed, and second, the nature of teachers' mathematical knowledge. It is believed excellent teachers of mathematics must know the mathematics appropriate to the grade level and primary mathematics subjects they teach [3, 4]. Also, researchers [5] summarised much of the then available research on teachers' mathematical knowledge for teaching (MKT) and noted a lack of it can impede teachers' abilities to notice and analyse students' thinking as well as their ability to engage in productive professional conversations.

Having been established that one of the most important factors which influence students' performance in mathematics are the mathematics teachers and the mathematics lessons they receive in school [6, 7]; it is significant that a comprehensive look is made into the college entry-level mathematical knowledge (ELMK), mathematics content knowledge (MCK) and mathematics pedagogical content knowledge (MPCK). The question therefore is, how do Ghanaian pre-service teachers become better at understanding mathematics content knowledge (MCK) and mathematics pedagogical content knowledge (MPCK) in ways that will give them flexibility and insight required for Mathematical Knowledge for Teaching (MKT) in the basic school?

In a study on 'improving teaching and learning of basic mathematics and reading in Africa' [8], it was found that even though initial teacher education programmes had impact on newly qualified teachers, they induced misplaced confidence leading to standardized teacher-led approaches that failed to engage learners. A researcher [9] in a previous study pointed out that graduates of teacher training colleges are ill-prepared in facilitating learning in basic schools. Similarly, it has been observed that most beginning teachers are seen as woefully unprepared for the complex and demanding tasks of the classroom and pre-service teacher education has been regarded as pathetically weak, resulting in new teachers being found wanting and desperate in their initial experience. This observation has not changed because pre-service teachers are still exhibiting weak performances in their 'End of Semester Examination' [10, 11, 12] giving the impression that there has been little improvement in mathematics performance over the years. Several researchers [13, 14, 15, 16, 17] have found that pre-service teachers do not always possess the conceptual understanding of the mathematics content they will be expected to teach. Colleges have not yet been successful in helping students become confident and competent in their teaching of some topics in mathematics [8, 18, 19, 20]. A study which focused on mathematical achievement of pre-service teachers, found out that pre-service teachers had a limited understanding of mathematics [21]. This finding of a basic level of mathematic coursework supports another work which found that teachers only had a cursory understanding of mathematics and lacked the ability to elucidate important concepts [22].

The researcher as a mathematics tutor in a Ghanaian Colleges of Education (CoEs) had observed how pre-service teachers struggled to grasp concepts during lessons. Colleague tutors in other CoEs have also complained about the quality of pre-service teachers they were training. A study conducted by several researchers [23] on behalf of the Professional Board of the Institute of Education, University of Cape Coast, identified the weak qualifications of entrants to colleges of education as one of the major factors of the prospective teachers' poor achievement in the end of training assessment as well as their overall preparedness to teach during their internship. They felt their performances were not up to expectation because of their background in mathematics. Also, there still remain significant number of students still trying to rewrite mathematics examination just for them to proceed to the next level in their academic journey [24]. Evidence abounds that many teachers enter the classroom without a comprehensive

understanding of mathematics [25, 26, 27, 28]. These concerns had been confirmed by the Diploma in Basic Education (DBE) Chief Examiner's report which pointed out that the general performance of the majority of candidates in their method course (Teaching Primary and Junior High secondary mathematics) was not satisfactory, in that, only a limited number of the candidates exhibited good mastery in areas tested as observed by the Institute of Education of the University of Cape Coast [10, 11, 12]. This is to say that the performance of pre-service teachers at the CoEs is nothing different from the performance of students at the basic level. This challenge if not looked into and curbed will jeopardize mathematics education in Ghana. Just as the problem of poor performance in mathematics can possibly be traced to pre-service teachers' lack of mathematical knowledge, the variables ((ELMK, MCK and ELMK) that contribute to the pre-service teachers' mathematical knowledge for teaching (MKT) is less researched into. For this reason, this study analyzed the relationship between entry-level mathematical knowledge (ELMK) and mathematics content knowledge (MCK) cum mathematics pedagogical content knowledge (MPCK) scores of Ghanaian pre-service teachers in CoEs. Thus, it addressed the question, "What is the predictive validity of pre-service teachers' college entry level mathematical content knowledge (ELMCK) on their mathematics content knowledge (MCK) and mathematics pedagogical content knowledge (MPCK)?"

Materials and Methods

This is a quantitative research which adopted the cross-sectional survey design. The rationale for using the design was that it relied on large-scale data from a representative sample of a population with the aim of describing the nature of existing conditions [29]. The target population was three thousand, three hundred and forty (3342) second-year or level 200 pre-service teachers in forty-six (46) public colleges of education in Ghana. Multi-stage sampling was used in sampling nine hundred and ninety-eight (n = 998, 30%) second year pre-service teachers from ten (10) conveniently selected public colleges of education for the study. These colleges were categorized into three geographical clusters of the Republic of Ghana, namely; the Southern, Central and Northern belts. Purposive sampling was used to pick level 200 students. The second-year group was purposively chosen because, with the curriculum of colleges of education, methodology courses which are actually pedagogical knowledge of the various subject areas are taught in second year besides the content knowledge studied in level 100. A combination of stratified and simple random sampling techniques was used to sample 998 (30%) pre-service teachers of the target population. The stratified sampling technique was used to categories and select the respondents based on gender. The simple random sampling technique using the lottery approach was then used to select 645 (65%) males and 353 (35%) female students from the sampled colleges of education. The choice of 15% of the population is based on the assertion that a sample size of 5 to 30 percent of the accessible population is appropriate for a descriptive survey [30]. Again, the sample size was deemed representative of the target population based on the recommendation that a sample size of 10% to 20% of the target population is representative in descriptive research [31].

Structured questionnaire, mathematics test items and unstructured observation schedule developed by the researcher were used to collect data for the study. These instruments were used because of the explorative and descriptive nature of the study. The instruments were pilot tested on twenty (20) level 200 students from Ada College of Education which did not form part of the actual field study. Internal consistency was tested on the questionnaire by means of Cronbach alpha statistics by means of Cronbach alpha reliability analysis via the Statistical Package for Social Sciences (SPSS) software version 22, and this yielded a Cronbach's alpha reliability coefficient (α) of 0.895. Secondary data was also collected in the form of mathematics test results from Institute of Education at University of Cape Coast. The data were described using descriptive statistics (frequency count, percentage, standard deviation) as well as inferential statistics (Pearson's correlation test, paired-samples t-test, regression analysis) which were computed at a significance level (p-value) of $p \leq 0.05$ (2-tailed) at a confidence interval (C.I) of 95% with a margin of error of ± 5. The statistical analysis was done with the aid of SPSS software version 22. The variables or constructs of interest in this study are: ELMCK, MCK and PMCK. ELMCK measures achievement (grade) in core

mathematics at WASSCE level. Content Knowledge in Mathematics (MCK) measures achievement in FDC 112 and FDC 122 as foundation courses at the college level. PMCK measures achievement in Mathematics Methodology (PFC 222) at the college level. The foundation courses are perceived to be the content courses whilst the MPCK course is the methodology (professional) course that the pre-service teacher is equipped with in the teaching of the basic school mathematics.

Results

Background information

Table 1. Background information of respondents (n = 998)

Variable	Freq	%
Sex		
Male	645	65
Female	353	35
Pre-entry mathematics grade into college		
A1	10	1.0
B2	73	7.3
B3	99	9.9
C4	106	10.6
C5	133	13.3
C6	526	52.7
D7	51	5.1

It is observed in Table 1 that more male (n = 645, 65%) than female (n = 353, 35%) pre-service teachers were used for the study. This result suggests that there were more male than female students in public colleges of education in Ghana. With regard to entry level grade in mathematics, the data collected and analysed indicated that many of the pre-service teachers (n = 947, 95%) had good entry grades of A1, B2, B3, C4, C5 and C6. Notwithstanding, only 1% had A1, 7.3% had B2 with 9.9% having B3. It could be seen that mathematical achievement as to obtaining from A to B was not that high. It is also clear from the table that 106 pre-service teachers representing 10.6% of the respondents had C4 with 526 pre-service teachers representing 52.7% had C6 as threshold entry level grade. It could conclude from the table that majority (76.7%) of the students in Colleges of Education had an entry-level mathematics grade 'C' category. Per some reasons of admitting those with D7 in the 2016/2017 batch of pre-service teachers, 51 of the respondents representing 5.1% had D7. This result suggests that about 77% or more of pre-service teachers who enrolled in Ghanaian Colleges of Education had relatively weak but average mathematics grades, and this signaled poor entry-level mathematical knowledge (ELMK).

Table 2. MCK performance of pre-service teachers in college (n = 998)

Variable	N	Minimum	Maximum	Cum.% below 50	Std Deviations
MCK	998	27	96	13.4	6.174

It is deduced from Table 2 that mathematical performance in the content courses in mathematics ranges from 27 to 96. With a threshold pass mark of 50%, it could be deduced that, some of the students failed to get the 50%. One hundred and thirty-four (134) representing 13.4 % of the students failed to get the pass mark of 50%. This shows that although the threshold entry grade 'C6' (ELMCK) was achieved by about 53% (52.7%) of the respondents, this could not be justified in their content course in mathematics (MCK) at the college level.

Table 3. Mathematics performance of pre-service teachers' PMCK in college (n = 998)

Variable	N	Minimum	Maximum	Cum.% below 50	Std Deviations
PFC 222	998	30	86	21.3	8.54

In Table 3, a higher percentage of failure was recorded in the mathematics professional course (PMCK). Evidence of it is the 21.3% total failure to attain the 50% mark. This is a clear indication that pre-service teachers' mathematical knowledge for teaching (MKT) basic school mathematics was low. The relationship between ELMCK and MCK as well as PMCK is further explored through paire-samples t-test and regression analysis which are presented in Tables 4, 5, 6, 7, 8 and 9.

Table 4. Pearson's Correlation between ELMCK and MCK (n = 998)

Variables		Paired relationship		r	df	p-value
		Mean	Std. Error Mean			
Pair	ELMCK-MCK	0.676	0.32	0.41	997	0.197

Key: r – correlation coefficient; df – degree of freedom; p-value or probability value

It is evident in Table 4 that the pre-service teachers' entry grades in core mathematics (ELMCK) and MCK was positively correlated with a correlation coefficient (r) of 0.41, but was not statistically significant with p–value = 0.197 which is greater than the threshold alpha level of 0.05, 2-tailed at a confidence interval (C.I) of 95%. This is an indication of a positive relationship between entry level grade in Core Mathematics ELMCK and the foundation course (MCK). It could deduce that, the pre-service teachers had better entry grades in core Mathematics (ELMCK) as compared to that of the MCK.

Table 5. Pearson's Correlation between ELMCK and MPCK (n = 998)

Variables		Paired relationship		r	df	p-value
		Mean	Std. Error Mean			
Pair	ELMCK- PMCK	0.593	0.251	-0.007	997	0.837

Key: r – correlation coefficient; df – degree of freedom; p-value or probability value

The relationship between mathematics achievement of pre-service teachers before entry into college (ELMCK) and their PMCK was found to be negative and not statistically significant; [r (997) = -0.007, p = 0.837, 2-tailed] at a confidence interval (C.I) of 95%. The negative correlation coefficient is indicative of the abysmal performance of the pre- service teachers in the pedagogy assessment (PMCK) which is a key factor in determining MKT. Table 6 presents information on whether ELMCK is predictive of MCK and PMCK.

Table 6. Paired-samples t-test of ELMCK on MCK and PMCK (n = 998)

Variables		Paired Differences			t	df	p-value
		Mean	Std. Deviation	Std. Error Mean			
Pair 1	ELMCK - MCK	0.676	13.050	0.413	1.638	997	0.102
Pair 2	ELMCK- PMCK	5.958	11.311	0.358	16.642	997	0.001

Key: t – test statistics; df – degree of freedom; p-value or probability value

There was no statistically significant difference in the scores for ELMCK (M=0.676, SD=13.050) and MCK; t (997) =1.638, p = 0.102. The mean difference between performance in ELMCK and MCK was positive (0.676), and this is an indication that pre-service teachers' performance or entry grade in core Mathematics (ELMCK) was better as compared to their MCK at college level. The difference was however not statistically significant ($p \geq 0.05$). This result is an indication that, the ELMCK of an individual does not necessarily predict a persons' MCK.

Comparatively, there was a statistically significant difference in the scores for ELMCK (M=5.958, SD=11.311) and PMCK; t (997) =16.642, p = 0.001 which is less than the threshold alpha level of 0.05). Although the mean difference between performance in ELMCK and PMCK was positive (5.958) and the difference was statistically significant, it is assumed that the predictive validity is not sustainable. Accordingly, regression analysis was carried out to further explore the predictive validity of pre-service teachers' ELMCK on MCK and PMCK at college.

A regression was conducted with PMCK as the dependent variable. ELMCK and MCK were computed in the regression model as controlled variables. The regression model was used to predict validity of mathematical variables on MKT. This is because, in assessing MKT, the relationship is established by use of correlation and then regression used for the prediction. For a linear regression, the equation;

$Y_i = \beta_{0i} + \beta_{1i}X + \varepsilon_i$ where, $\varepsilon_i \sim N(0, \sigma^2)$

Y_i is the predicted dependent variable,

β_{0i} is cosntant

β_{1i} is the unstandardized regression coefficient

X is the value of the predictor variable.

ε_i is the error term

Table 7. Model summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.041[a]	.002	.001	11.145	.002	1.663	1	996	.197
2	.0.007[b]	.000	.001	8.647	.000	0.042	1	996	.837
3	.047[c]	.002	.001	8.638	.002	2.191	1	996	.139

Table 8. ANOVA

Model		Sum of Squares	df	Mean Square	F	p-value
1	Regression	205.997	1	206.897	1.663	.197
	Residual	123892.755	996	124.990		
	Total	124099.652	997			
2	Regression	3.188	1	3.166	0.042	0.837
	Residual	74468.945	996			
	Total	74472.011	997			
3	Regression	163.483	1	163.483	2.191	.139
	Residual	74308.528	996	746.07		
	Total	74472.011	997			

From the model summary and ANOVA, it was revealed that in model one, ELMCK contributed to the regression model, $(F\,(1{,}998) = 1.663, P = 0.197)$ and accounted for 0.19% of the variation in ELMCK and MCK. Also, from the model summary, it could be noticed that the p-value (0.0197) was not statistically significant though some variations were recorded. With regard to the ELMCK and the PMCK, a recording of $(F\,(1{,}996) = 0.042, P = 0.837)$ also accounted for about 0.84% of the variation in ELMCK and PMCK. It could be noticed that the p-value (0.837) which is far bigger than the threshold value of 0.05 was not statistically significant. Furthermore, when the MCK and PMCK were computed to ascertain the predictive

validity, a recording of $(F\,(1{,}996) = 2.191, P = 0.139)$ also accounted for about 0.14% of the variation in MCK and PMCK. Here too, it could be noticed that the p-value (0.139) was also not statistically significant.

Table 9. Coefficients of regression

Model	Unstandardized Coefficients		Standardized Coefficients	t	p-value
	B	Std. Error	Beta		
(Constant)	57.817	3.006		18.860	0.001
ELMCK	0.063	0.049	0.041		0.197
(Constant)	56.949	2.377		23.960	0.001
ELMCK	-0.008	0.038	-0.007	-206	0.837
(Constant)	54.222	1.538		23.960	0.001
MCK	0.036	0.025	0.047	1.460	0.139

From Table 9, it is evident that ELMCK did not statistically and significantly predict pre-service teachers' performance in MCK at the college level. In the same way, ELMCK did not statistically and significantly predict pre-service teachers' performance in PMCK in college. On the predictive validity with regard to MCK and PMCK, though the output showed that it was not statistically significant, the variation was not as wide as compared with the ELMCK. This is an indication that, for one to build enough MKT for teaching basic school mathematics, a lot of factors can be considered besides the entry level mathematics the person has. On observation and reflection of the teaching and learning of mathematics in Ghana, some students had a phobia for the subject and that may contribute to poor performance.

Discussions

Evidence gathered from the findings of this study indicate that the majority (about 77%) of pre-service teachers in Ghanaian Colleges of Education had relatively weak but average entry level mathematics grades (ELMK). Most of the pre-service had grades C4, C5 and C6 as the threshold entry level grade, and this signaled weak ELMK. The findings give credence to result by other researchers [23] who identified the weak qualifications of entrants to colleges of education. Several researchers [9, 13, 14, 15, 16] affirmed that pre-service teachers are woefully ill-prepared and had a limited understanding of foundation mathematics. The implications of the findings suggest that entry level mathematics knowledge (ELMK) is very important to the pre-service teacher since he or she will have to build on it to acquire the MKT to teach basic school pupils. Despite the importance of mathematics to the teacher, this research discovered that, individual pre-service teachers might have different levels of ELMK and that it depends on college mathematics teacher educators or tutors to develop the various levels of ELMK into the needed MCK, PMCK and MKT by the pre-service teacher.

The study found that although the threshold entry grade 'C6' (ELMCK) was achieved by about 53% of the pre-service teachers, this could not be justified in their content course in mathematics (MCK) at the college level. This suggests that pre-service teachers' mathematical knowledge for teaching (MKT) basic school mathematics is low. The finding is parallel to the views of other researchers [25, 26, 27, 28] who documented that many teachers enter the classroom without a comprehensive understanding of mathematics.

The findings found a positive relationship between ELMCK and MCK of the pre-service teachers at the college level. The pre-service teachers had better ELMCK as compared their MCK. This positive relationship between the ELMCK and the MCK might be due to the fact that some of the content courses at college (MCK) and are familiar with the content courses learn at the secondary school level. Pre-service teachers' ELMCK and MCK was positively correlated, but not statistically significant ($p \geq 0.05$). Hence, ELMCK did not necessarily predict MCK of pre-service teachers. The findings validate the views of several researchers [28, 32, 33, 34, 35] who indicated that teachers'

background subject knowledge directly influences students' achievement.

The study established a negative correlation between ELMCK and PMCK of the pre-service teachers. This finding is indicative of the abysmal performance of the pre- service teachers in the pedagogy assessment (PMCK) which is a key factor in determining MKT. Notwithstanding, ELMCK significantly predicts PMCK of pre-service teachers ($p \leq 0.05$) but the effect size was statistically negligible and not sustainable. Several researchers [28, 32, 33, 34, 35] made similar findings. The performance of pre-service teachers in the PMCK was abysmal because it is assumed that PMCK is a new area to the pre-service teachers. The researcher also shares same view that the PMCK course is new to the pre-service teachers and therefore they could not grasp it immediately. The findings suggest that for pre-service teachers to build adequate MKT for teaching basic school mathematics, a lot of factors need to be considered besides the entry level mathematics knowledge (ELMK) of the pre-service teacher. A casual observation and reflection by the researcher points to the issue of phobia for mathematics by some students during the teaching and learning of mathematics in Ghana; this might contribute to poor performance in MCK and PMCK. Should these pre-service teachers fail woefully in these courses (MCK and PMCK), and then what will be the guarantee that they will have the need MKT to teach it in the basic school? In this regard, PMCK must be taken serious in Ghanaian Colleges of Education and more time must be allocated to it by policy makers for strong MKT to be built.

Conclusions

It could be concluded from the study that, CoEs in Ghana admit pre-service teachers with average but weak background in mathematics (ELMK). Again, the performance of pre-service teachers in ELMCK and MPCK as well as MKT is partly dependent on ELMK of pre-service teachers and various factors such as mathematics phobia and pre-service teachers' attitudes to mathematics. It is believed that many pre-service teachers, who are trained in CoEs in Ghana to teach mathematics in basic schools after college, are without firm grounding in MKT. For pre-service teachers in Ghana to take up the job of teaching mathematics to basic school pupils, there should be a level of combination of different theories which should in turn be translated to practice. In this regard, pre-service should be given ample time for professional or pedagogical practice during internship or teaching practice (practicum) while in training. In view of the findings and conclusions drawn from the study, the following recommendations are put forward:

1. The Ghana Tertiary Education Commission (GTEC), which was hitherto known as the National Council for Tertiary Education (NCTE) and the National Accreditation Board (NAB) in liaison with the Principals of Colleges of Education in Ghana should peg the entry grade (ELMK) of C6, and D7 in mathematics for especially those who will not be specializing in mathematics.
2. Mathematics tutors in Ghanaian Colleges of Education should organize remedial lessons for pre-service teachers to scale-up their mathematics content knowledge (MCK), procedural and pedagogical knowledge or professional mathematics content knowledge (PMCK). This would step up their mathematical knowledge for teaching (MKT) mathematics in Ghanaian basic schools.
3. Mathematics tutors in Ghanaian Colleges of Education in collaboration with Principals of Colleges of Education should re-organize the internship programme of the colleges of education to make them more effective in training pre-service teachers who specialize in mathematics and other subject areas.
4. Mathematics tutors in Ghanaian Colleges of Education in collaboration with Principals of Colleges of Education and Ghana Tertiary Education Commission (GTEC) should structure and introduce the methodology course (PMCK) alongside the content course (MCK) for pre-service teachers since the separation of content and method courses often create disconnect for pre-service teachers and tutors as well as researchers. This is to ensure that more time is given to the pre-service teachers to explore MKT in a manner in which they are expected to teach.
5. It is also recommended that The National Council for Tertiary Education (NCTE) design and provide official textbooks and tutor's handbooks for the CoEs to ensure that MCK and PMCK topics are treated in a more practical way.
6. A national committee of experts in mathematics should be put together by GTEC

and NCTE to collaborate with the Ghana Education Service (GES) to consider the drastic reduction in the mathematics syllabus at the basic school level with a view to have fewer topics to ensure in-depth treatment of the topics which should lead to better understanding of mathematical concepts and relevant applications to everyday living. This will help pre-service teachers have fewer topics to cover but with in-depth understanding and mastery to develop their MKT.

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