

# **Analyzing the Determinants of Teachers' Mathematics Teaching Competencies in Upper Primary Phase: Evidence from Namibia**

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**Abstract:** The purpose of this study was to assess the extent to which predictors of teachers' competencies in teaching mathematics predict the outcomes of mathematics performance among learners at upper primary phase. The determinants were namely gender, teaching experience, region, qualification, and fields of study exert effect on teachers' competencies in lesson planning and preparation, assessment and evaluation of learners, lesson delivery, the use of teaching strategies, the quality of homework, and the availability of teaching materials. The generic understanding of the impacts of predictors of teaching competencies on learners' performance significantly informs the development of training programmes components, and teaching and learning processes across the schooling system. Shulman's theory of teacher content and pedagogical knowledge underpinned the study. The study comprised of holistic samples of 117 mathematics teachers at upper primary phase teachers from 39 schools. The selection of three schools from each region followed three criteria, namely outstanding, moderate, and lower performances in Grade 10 examination. Data is collected from classroom observation and analysis of relevant documents. The findings show that predictor variables such as gender, teacher qualification, teaching experience, field of study, and region exerted effects on the way teachers plan and prepare the lesson, deliver the lesson, assess and evaluate learners, use the teaching materials, and the quality of work. Teachers who specialized in mathematics were more competent in mathematics teaching. The results presuppose that predictors of teachers' competencies in teaching mathematics are essential for improving teaching and learning of mathematics in schools. The outcome of this study is beneficial to education officials who are directly responsible for coordinating the teaching of mathematics in schools and the allocation of teaching subjects, particularly mathematics. The findings showed that a number of teachers were not trained mathematics. This was an indication of the existing shortage of mathematics teachers in schools nationally. Untrained mathematics teachers negatively influenced learners' performance. These outcomes implied that education planners at the national, regional and district levels should set up strategies on how to increase the production of mathematics teachers nationally in order to meet the demand of such teachers in schools.

**Keywords:** Competencies, Mathematics, Content knowledge, Pedagogical knowledge, Field of study, Qualification, Specialized content knowledge, Business mathematics

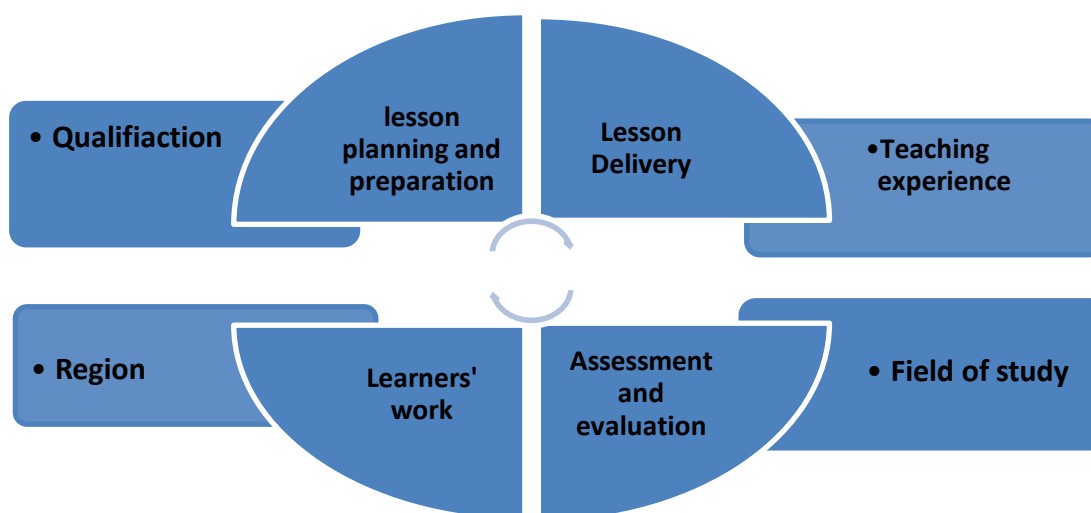
## **1. INTRODUCTION**

It is reasonably construing that teacher competency in teaching mathematics affects learners' performance. This elucidation is globally applicable in mathematics teaching. Evidences in Namibia indicate that teachers' incompetency in teaching mathematics and inability to master the curriculum content negatively influences the learners' performances (NIED, 1998, 2010; DNEA, 2004; MASTEP, 2002; MEC, Florida State University & Harvard University, 1994 and Shiel and Kelly, 1999).

The Upper Primary Mathematics Facilitators Training Workshop conducted by NIED (2006) listed twenty four factors attributing to low performance in Mathematics among the learners of which the following are directly related to teachers' competencies in teaching Mathematics:

1. Lack of the teachers' subject-content knowledge;
2. Lack of pre and in-service teacher training;
3. Lack of support from subject advisors;
4. Inability to teach higher level competencies
5. Inappropriate qualification and;
6. misallocation of subject to teachers who did not specialize in the subject.

A national study was conducted exploring reasons for learners' poor performance in mathematics. One of the tasks of the researchers was to assess teacher's competencies in teaching mathematics. The researchers used the standardized classroom observation instrument in all school in Namibia during the internal and external evaluation of teachers. For the purpose of this research, the researchers used section 1: Lesson planning and preparation, section 3: lesson presentation, comprises of lesson delivery, teaching strategies used during presentations, learners engagement and teaching, learning aids, section 4: learners' work in class (class activities, written work and homework) and section 5: Assessment and evaluation during the lesson. These sections matched to predictor of teaching competencies, namely, qualification, field of study, gender, teaching experience, and region. Figure 1 presents a conceptual integration of determinants of teachers' teaching competencies:



**Figure 1:** Integration of determinants of mathematics teaching competencies

Lesson plan and preparation entail teachers ability to use the syllabus and textbooks to plan a lesson, holistic understanding of the required basic competencies for learning, and lesson objectives. The link of the lesson plan to the scheme of work and year plan is an expected competency of competently trained teachers. This knowledge is hypothetically determined by the level of qualification, teaching experience, field of study, region where teachers reside and gender. Putatively, lack of content and pedagogical knowledge impounds the attainment of basic competencies and lesson objectives.

Ball et al. (2008, p.6) note, "In analysing video of teaching, it became obvious, especially when teachers lacked common content knowledge, that such knowledge is essential. When teachers mispronounce terms, made calculation errors, or got stuck trying to solve a problem, instructions suffered and valuable time was lost". In essence the lesson plan exerts influences on the lesson delivery and the use of teaching strategies which tangles subject content knowledge, and effective communication with learners using their prior experience and knowledge.

Again, this view conjuncts Ball et al. (2008) conception that divided the Shulman's content knowledge and pedagogical knowledge into four categories namely content knowledge, specialized content knowledge and students and knowledge of content and teaching.

Another aspect of effective and competent teaching is the assessment and evaluation during lessons. To what extent do the level of qualification, teaching experience enhance understanding of learner's level of content knowledge and learning styles? How does the field of study that entrenches subject content and pedagogical knowledge determines the teachers' competencies in teaching mathematics? A competent teacher connects lesson plan and preparation, lesson delivery to assessment and evaluation. This process requires in-depth internalization of subject contents knowledge, pedagogical knowledge, and learners' ability to master the contents by considering gender, language, culture, motivation, prior knowledge, and skills (Glatthorn, 1990, in INTIME, 1999-2001). To be able to assess high-level learning and critical thinking, it is essentially important for teachers to have a combination of skills that are above the level of content knowledge, pedagogical knowledge and specialized content knowledge required for the grade. Teachers' multifaceted teaching competencies, impacts on the ability to develop teaching materials, improve the type and quality of learners' work and the type of question to assess learning is the focus of this paper.

### **1.1 Problem statement**

Ideally, trained mathematics teachers and teaching experience in subject area among many other factors influence the learners' performance (Ahuja, 2005). It implies thereof that allocation of mathematics teachers according to content knowledge attained through teacher training and teaching experience is essential for attaining optimal learners' performance in mathematics. Contrary to these conceptions, due to shortage of mathematics teachers in school added to misallocation subject to teachers in schools, numbers of teachers currently teach mathematics without having the required qualification or experience in teaching mathematics. The lack of teaching competencies queries the attainment of optimal learners' performance in mathematics (NIED, 1998, 2010; DNEA, 2004; MASTEP, 2002; MEC, Florida State University & Harvard University, 1994 and Shiel and Kelly, 1999). The extent to which other determinants of teachers' competencies in addition to qualification and experience such as school location, regions and gender affects learners' performance is not known. This explorative study examined the determinants of teachers' competencies in teaching mathematics through a thorough classroom assessment using regression analysis.

## **2. LITERATURE REVIEW AND THEORETICAL MODEL CONSTRUCTION**

### **2.1 Shulman's theory of teacher knowledge**

A suitable theory for this study is Shulman's theory of teacher content and pedagogical knowledge. Shulman (1986) views that contents knowledge and pedagogical knowledge are essential components of teachers' competencies in teaching. This view opposed the traditional approach that thinly appts teachers' competencies in classroom practices and disregarded the content knowledge. Shulman refers to content knowledge as an overall ability to organize various aspects of the domain of the subject, rules and propositions embedded in thereof. Furthermore, Shulman discusses forms of knowledge such as propositional knowledge, case knowledge and strategic knowledge and links them to content, pedagogical and curriculum knowledge. The type of propositions, namely, principles, maxims and norms augur the traditional emphasis on lesson planning and preparation, teaching strategies, lesson delivery, assessment and evaluation, teaching materials and type and quality of learners' work that this study examined. Figure 1 presents a conceptual amalgamation of elements of these propositions.

### **2.2 Empirical literature review**

The anecdotal evidence suggests that teachers' teaching experience, qualification, field of study, gender and location, in general, exerts influence on teachers' teaching competencies.

More evidence, especially on studies in mathematics and teachers' teaching competencies documents, curriculum, demographic, cultural (Blömeke, and Delaney, 2012) and methodology as hallmarks in influencing teachers' competencies in teaching mathematics (Clarke, 2003). Ahuja (2005) in a comparative study of Indian and American high schools that performed outstandingly in mathematics, found that content knowledge with experiential and professional knowledge plays an important role in assisting teachers to adapt curriculum contents and thus influences teachers' teaching competencies and learners' performance in mathematics. These findings confirm the essence of three determinants of teachers' teaching competencies that are among the key determinant areas used in this study namely: experience, qualification, and field of study.

Contrary to the assertions that content knowledge determine the teachers' competencies in teaching mathematics, is that content knowledge can be very deceptive since evidence shows that teachers who are well trained, and rich in content demonstrate limited ability in teaching mathematics, resulting, in low learners' performance in mathematics (Gallagher, 2002, Mareike et al., 2013). While, in some cases, teachers' teaching competencies and learners performances are moderately related (Duran, 2004). Congruently, Griffin (2012) found that competent teachers failed to impart higher order level of learning when applying Vygotsky (1974) Zone of Proximal Development teaching strategy.

Spilkova (2001) contends that teachers' teaching competencies are based on reflective practices, subject knowledge, attitude, experience, and values. The mathematics teaching competencies conception further dwells on a number of competencies that are essential in determining teachers' competencies namely, knowledge of the principles of learning, pedagogical knowledge, and subject knowledge (Bromme, 1994, Harel & Kien, 2004). Similarly, Carpenter, Fennema & Franke (1996) model shows the dynamics that take place in classroom of which contents, pedagogical knowledge, and teacher beliefs essentially regarded as determinants of teachers' competencies in teaching. Helus (2001 in Hospesová and Tichá, 2005) equally submits that teachers' competencies comprise of a bundle of activities (Scherer & Steinbring, 2003) that take place during classroom instructions.

Earlier research conducted by Conchram et al. (1993) demonstrates another dimension to the teaching competencies that correspond to the teaching experience such as knowledge of the learners' background. While Krainer's (1994) study pronounces self-growth and teaching experiences as essential components of teachers' competencies. Santaga et al. (2007) espouse that specific field experiences enable teachers to merge theory into practice. Henceforth, that when planning a lesson, experienced teacher determine better strategies for teaching compared to inexperienced teachers (Housner & Griffey, 1985).

## **3. METHODOLOGY**

### **3.1 Design**

To assess the teachers' competencies, it was essential to attempt an approach that provided a broader understanding of the link between the determinants of teachers' competencies in teaching mathematics and the competency areas as stipulated in the National External School Evaluation (NESE) classroom evaluation form. Following this consideration, the study attempted quantitative and qualitative research approaches. Particular techniques that comprised the two paradigms were observation, document analysis specifically of subject objective files that contained syllabus, scheme of work, subject policy guidelines; lesson preparation files, administration file containing official circulars, assessment file, learners' exercise books and homework, and observation of visual aids or teaching materials displayed in the classrooms. Such triangulated techniques were further evident using different instruments in collecting data and data analysis methods.

### **3.2 Data collection**

To be able to determine the effects of the predictors of teachers' mathematics teaching competencies, it was necessary to observe the teaching of mathematics in Upper Primary Phase in the selected schools. The classroom observations were done in 39 randomly selected schools.

The criteria for selecting the schools were the performances of the schools in grade 10 examinations. A sample of three schools per region was later drawn. A holistic sample of teachers was drawn, because a common practice in most of the schools was that one mathematics teacher taught mathematics across the phase. Due to variations on enrolment in schools and the regions, an estimated number of three teachers per school was considered as a basis for determining the sample size of teachers. The planned and achieved sample size of mathematics teachers was 117.

In collecting data and evaluating the classroom practices in teaching mathematics, it was crucial to use an instrument that was standardized and already used in schools. This study used the NESE classroom observation form. School principals, particularly NESE team uses classroom observation instrument for assessing teaching and learning in schools. For the purpose of this study, the study used a section of NESE classroom observation instrument that focuses on classroom practices. The outcomes or assessed competencies were taken from the NESE evaluation form without modifications. A mathematic expert who was a member of the research team conducted the observations. The classroom observation yielded quantitative data. The researchers took detailed field notes while observing the classroom interaction. The presentation and interpretation of the classroom observation, notes, and document analysis were combined in order to complement the different methods used in this design. This approach improved the validity, reliability, trustworthiness, and credibility of the data collection methods, analysis and the findings.

### **3.3 Data analysis**

The data was categorised by region, qualification, teaching experience, gender and field of study to determine the extent to which the distinct categories determine teachers' competencies in lesson planning and preparation, delivery of mathematics lesson, assessment and evaluation of learners, use of teaching strategies, quality of homework, and availability of teaching material. Data was analysed using SPSS software. Regression analysis, specifically the *beta* statistics were computed. The aim of this computation was to find out the extent to which the predictor variables such as region, gender, teacher qualification, teaching experience, and field of study exerted effects on the teachers' competencies in lesson planning and preparation, delivery of mathematics lesson, assessment and evaluation of learners, use of teaching strategies, quality of homework, availability of teaching material. All effect variables were entered at once into the linear regression model. The outcome variables or determinants of teachers teaching competencies were entered into the linear regression model individually as the model specifies.

## **4. INTERPRETATION OF THE RESULTS**

The interpretation of the findings of this study was based on the analysis of standardized coefficients *beta*, and the probability levels of the five determinants of teachers' teaching competencies, namely, lesson planning and preparation, delivery of mathematics lesson, assessment and evaluation of learners, use of teaching strategies, quality of homework, availability of teaching material separately. To be able to get the accurate *effect* size, the standardized coefficients *beta* were observed. Beta parameters range between negative or positive 0-1 whereby 1 is the strongest. Statistical significant were assessed at 0.05 level ( $<0.05$ ).

### **4.1 Determinants of teachers' competencies in lesson planning and preparation**

Table 1 presents regression coefficients of teachers' competencies in lesson planning and preparation. The standardized coefficients (*beta*) of teacher qualifications with *beta* weight of .347 and regions where teachers came from with *beta* weight of -.359 exerted influence on the way teachers planned and prepared mathematics lessons. The existing disparities in the regions had detrimental effect on the provision of quality education.

Region was significant at  $p=.027$  and teachers' qualification at  $p=.030$ . The results would have appeared different by classifying the variable region into three dummy variables namely, rural, urban, and semi-urban.

**Table 1:** Coefficients of determinants of teachers' competencies on lesson planning and preparation

	Unstandardized Coefficients		Standardized Coefficients	t	Sig
	b	Std. Error	beta		
Region	-.055	.024	-.359	-2.321	.027
Gender	-.045	.184	-.037	-.245	.808
Field of Study	-.055	.054	-.163	-1.030	.311
Experience	.065	.077	.137	.852	.401
Qualification	.095	.042	.347	2.273	.030

More evidence though not emphatic was the field of study with a *beta* weight of -0.163 that implied that field of study had no influence on the teachers' competencies in lesson planning and preparation. It further inferred from the findings that teachers who specialized in mathematics or had it as a major subject demonstrated less competencies in lesson planning and preparation. These results provide misleading evidence on teachers' competencies.

**4.2 Determinants of teachers' competencies in lesson delivery**

On teachers' competencies in lesson delivery, the *effect* size, demonstrated from the standardized coefficients (*beta*) show that the field of study with *beta* weight of .326 followed by gender, (-.157), qualification (-.134), region (.128) and experience (.038) influenced the way teachers delivered the mathematics lesson. It was further evident and equally alarming, that qualification (-.134) and teaching experience (.038) exerted weak influence on the way teachers delivered the mathematics lesson.

**Table 2:** Coefficients of predictors of teachers' competencies on lesson delivery

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Region	.017	.023	.128	.732	.470
Gender	-.164	.180	-.157	-.911	.370
Field of Study	.096	.052	.326	1.823	.078
Experience	.016	.075	.038	.212	.834
Qualification	-.032	.041	-.134	-.778	.443

**4.3 Determinants of teachers' competencies in the use of teaching strategies**

The results in table 3 show that field of study with *beta* weight .410, and gender -.264 exerted influences on the way teachers utilized a variety of teaching strategies to assist learners to master mathematics skills. Surprisingly, qualification with *beta* -.060, experience -.081 and regions .100 where teachers taught exerted weak influence on teachers competencies in the use of teaching strategies. There were significant differences between the field of study and the use of different teaching strategies ( $p=.02$ ), which hypothetically implied that field of study influenced the teachers' competencies on the use of teaching strategies.

**Table 3:** Coefficients of teachers' teaching competencies on the use of teaching strategies

	Unstandardized Coefficients		Standardized Coefficients	t	Sig
	B	Std. Error	Beta		
<b>Region</b>	.015	.025	.100	.595	.556
<b>Gender</b>	-.309	.195	-.264	-1.585	.123
<b>Field of study</b>	.135	.057	.410	2.379	.024
<b>Experience</b>	-.037	.081	-.081	-.461	.648
<b>Qualification</b>	-.016	.044	-.060	-.363	.719

#### 4.4 Determinants of teachers' competencies on the availability of teaching materials

As shown in table 4, gender exerted more influence on the way teachers' availed time and efforts in preparing the teaching materials by observing the standardized coefficients *beta* (-.206). The findings further inferred that there might have been differences between gender groups in availing mathematics teaching materials. The *beta* weighing exerted by teaching experience (-.190) and field of study (.167) on availability of teaching materials could logically assume that the teaching experience and the knowledge on the subject attributed to variance in material production. There were no significant differences observed on teachers' competencies in availing teaching materials to the classroom and encouraging learners to produce teaching materials.

**Table 4:** Coefficients of determinants of teachers' competencies on the availability of teaching materials

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
<b>Region</b>	-.008	.027	-.051	-.280	.781
<b>Gender</b>	-.243	.211	-.206	-1.152	.258
<b>Field of Study</b>	.055	.061	.167	.901	.375
<b>Experience</b>	-.088	.088	-.190	-1.009	.321
<b>Qualification</b>	-.016	.048	-.060	-.334	.741

Classroom observations results revealed that teachers were not actively engaged in preparation of teaching materials. Although there were few displays of the mathematics teaching materials on the walls and notice boards in some of the classrooms, majority of the classrooms walls were empty. Teachers developed teaching materials during the Professional Development (CPD) training workshops that they attended. Teachers displayed these teaching aids in the classroom walls. Classes taught by especially novice teachers were exceptional. The reasons given by teachers, among many, for not being able to avail teaching materials were: insufficient school funds to buy the appropriate teaching materials; it was difficult for schools and teachers in remote rural areas to avail teaching materials; there were no training given to teachers on how to use surrounding artefacts to develop teaching materials.

#### 4.5 Determinants of teachers' competencies on the assessment and evaluation of learners

A serious shortcoming on mathematics teaching in schools falls on the assessment and evaluation of learners. Teachers in many of the observed classrooms were not competent in assessing learners. It was found that teachers whose field of study was mathematics were more competent in assessing and evaluating learners' work compared to those whose field of study was not mathematics. The *effect size* determined by *beta* weight of .389 revealed that field of study contributed immensely on teachers' competencies on assessment and evaluation of learners. Followed by region (-.155) where teachers taught, and gender (-.121). Surprisingly, qualification with *beta* weight .023 and experience

with *beta* weight -.038, had weak influence on teaching competencies in assessment and evaluation of learners.

**Table 5:** Coefficients of teachers' competencies on assessment and evaluation of learners

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. error	Beta		
<b>Region</b>	.033	.037	.155	.885	.383
<b>Gender</b>	-.200	.285	-.121	-.703	.488
<b>Field of Study</b>	.180	.083	.387	2.166	.038
<b>Experience</b>	-.025	.118	-.038	-.210	.835
<b>Qualification</b>	.009	.065	.023	.131	.896

Hypothetically, the field of study that provides teachers with content knowledge and pedagogical knowledge positively influenced teachers' competencies in assessment and evaluation of learners. It was therefore not surprising to note significant differences between teachers' field of study and teachers' competencies in assessment and evaluation of learners ( $t=2.17, p=.038$ ).

#### 4.6 Determinants of teachers' competencies in providing quality work to learners

On the provision of quality work to learners, the results presented in table 6 suggest that field of study with a *beta* weight of .299 impacted on the teachers' competencies in providing quality work to learners followed by region -.187, qualification .072, experience .011 and lastly gender .009.

**Table 6:** Coefficients of teachers' competencies on type the of learners' work

Predictors	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
<b>Region</b>	-.029	.028	-.187	-1.057	.299
<b>Gender</b>	.011	.213	.009	.051	.960
<b>Field of Study</b>	.103	.062	.299	1.651	.109
<b>Experience</b>	.005	.089	.011	.059	.953
<b>Qualification</b>	.020	.048	.072	.411	.684

It was observed that the quality of work of teachers who did not specialize in mathematics or those who had low qualification and less years of teaching experience, did not meet the required standard. In many cases, learner's work was not controlled. The correction of mistakes was not consistent. Peer marking was in practice only in some classes, and teachers did not make follow-ups to ensure the correctness of a mark obtained through peer marking. This was a precarious status quo.

## 5. DISCUSSIONS OF THE FINDINGS AND CONCLUDING REMARKS

The results of this study indicate that qualification and region influenced the way teachers planned and prepared mathematics lessons. Competency in lesson planning and preparation, requires in-depth cognition that is essential in translating the contents of the mathematics syllabus and breaking them into minute components that are cooperated into the lesson plan and preparation. In essence, lesson planning and preparation require skills in merging content and pedagogical content knowledge (PCK). Shulman 1987 in Lim and Guerra (2013, p.3) contends, "PCK referred to the ability of competent teachers to demonstrate subject content knowledge skills and applying specific teaching approaches that the help students to transform the content knowledge and link it to pedagogic knowledge." It thus makes sense alluding that qualified teachers who are assumed to be equipped with subject



content and pedagogical knowledge are more able or competent to translate the syllabus content into scheme of work and compile lesson plan and preparation.

To teachers, conceptualisation of mathematics knowledge and pedagogical principles are crucial (Othman 1995) in managing the curriculum and assessment principles (Smith, 2001; Othman, 2002). Henceforth, teachers with low qualification will have trouble in developing lesson plan and preparation.

It was not surprising that the field of study exerted more influence on the teachers' ability to deliver mathematics lessons compared to the remaining predictors of teachers' competencies. Teachers who specialized in mathematics or had it as a major subject have the advantages of both content and pedagogical knowledge since such knowledge is acquired during teacher training programme. Blömeke and Paine (2008) strongly supported this viewpoint by accentuating the fact that pedagogical knowledge is a knowledge typically acquired in a teacher-training program. Subject content knowledge and pedagogical knowledge make it easy for teachers to deliver mathematics lesson. The effective delivery of mathematics content in schools will influence positively on business mathematics skills among business students at tertiary institution. According to Shulman (1987) mathematics content knowledge and pedagogic knowledge are essential components that enable teachers to apply professional understanding. "A mathematics teacher has to know about typical preconditions of students and how to represent a topic in the best possible way. Curricular knowledge is part of it and includes teaching materials and curricula" (Blömeke & Delaney, 2012, p.8). Teachers whose field of study was not mathematics have insufficient content and pedagogical knowledge to be able to deliver mathematics lessons.

The finding on teachers' competencies in delivering mathematics lessons is in line with McBer (2000 in Davis, 2000) that refers to teaching skills, professional characteristics and classroom environment as predictors that contribute 30% of variance in learners' achievement. Although there was weak influence of qualification on the lesson delivery, the unstandardized coefficient though not a good measure of *effect size* implied that there were teachers who had relevant qualifications and perhaps field of study but were not competent in teaching mathematics, while some who did not have appropriate qualification and field of study demonstrated competency in teaching mathematics. In this case, learners' performances demonstrate the deceptions of the results (Gallagher, 2002). The deception of the results may be applicable to business management students who are compounded to take business mathematics in their first year although there is little evidence to assume this premise.

Interestingly, the field of study played a major role in teachers' competencies on the use of a variety of teaching strategies. These findings are not surprising since varieties of teaching strategies introduced to teachers who specialize in mathematics in order to enhance the pedagogical knowledge. The competencies in teaching mathematics gained by teachers whose field of study was mathematics corresponded to Harel and Kien (2004) three critical components of teachers' competencies namely: knowledge of mathematics content, knowledge of principles of learning, and methods of teaching mathematics. Henceforth, teachers who did not specialize in mathematics were not knowledgeable in the use of different teaching strategies. Such teachers lacked the knowledge that was essential in facilitating an opportunity for learners to "Interact with the mathematics; to deal with mathematics ideas, address mathematics concepts, learn skills, and develop the ability to apply mathematics knowledge (McNamara et al., 2002, p.2). The inability to apply mathematics ideas, concepts, and skills among the business management students in higher education is an evidence of the weak mathematics foundation at secondary level.

The findings on the use of varieties of teaching strategies and delivery of mathematics lesson are congruent to Shulman's (1986, 1987) theory of pedagogical knowledge and its relationship to content knowledge. Shulman's theory states that content and pedagogical knowledge are prerequisites for affecting teachers' competencies. The theory further professes that teachers whose field of study was not mathematics could be competent in the use of different strategies when they have accumulated years of teaching experience and acquired competencies in teaching and use of strategies through experiential learning and modelling. The opposite is also evident (Feinam-Nemser & Buchmann,

1985). Similarly, Lim and Guerra. (2013) echo that effective teachers differ from novice teachers in the way they present mathematic lessons (Grossman, 1990; Zimmerlin & Nelson, 2000).

In line with this evidence, it makes sense concluding that in many circumstances, business mathematics lecturers are not equipped with pedagogic knowledge to be able apply different strategies in lecturing the business mathematics.

To be able to conduct effective assessment and evaluation of learners' mathematic skills, mathematic teachers should have a combination of field of study, qualification, and experience in assessment and evaluation of learners. It was not surprising that field of study exerted weight on the way teachers assessed and evaluated learners' mathematics skill. According to the findings, it made sense concluding that teachers who did not specialize in mathematics experienced problems in assessing learners. Assessment comprised of designing assessment tools that take into consideration the type of competencies in various mathematics areas. This requires a deeper knowledge in mathematics content and pedagogic knowledge (Hill, Ball & Schilling, 2003; MET, 2010), acquired through subject specialization. Slight weight exerted on region and gender was of interest since they implied that regions differed on the way they conducted assessment and evaluation of learners.

The discrepancies exerted on the regions on assessment and evaluation of learners presupposed that administration of regions differs in terms of teachers' qualification and teachers who specialized in teaching mathematics. These findings inferred that teachers in the regions varied in terms of field of study, qualifications, gender, and experience in teaching mathematics. Logically, such variations affect mathematics-teaching competencies in the regions. These findings slightly contradict Ahuja's (2005) findings that teachers' practices and pedagogical choices are shaped by interest in the subject and that teaching competencies can be embedded in the school context (Helus, 2001 in Hospesová and Tichá, 2005), making school context and the region to play essential roles in developing teachers' mathematics teaching competencies. While expecting pedagogic content to influence the assessment strategies, business mathematics lecturers who master the mathematic content but lacks pedagogic knowledge may not be in a position to apply different assessment strategies.

According to the findings, gender exerted effects on the way teachers avail time and preparation of teaching materials. These findings might infer that when the influence on availing teaching materials increases among one gender group, it drops among another gender group. More specifically, it inferred that when male teachers' competencies in availing teaching materials increase, the female competencies dropped and vice versa. Evidences supporting this assumption need further exploration. The quality of learners' work has raised concerns among the mathematics educators. With lack of effective leadership and management in schools, teachers in some schools tend not to care much about the quality of work provided to learners. This was applicable to both class exercises and homework. It was evident according to classroom observation that no effort was taken in controlling learners' class and homework by the school managers in some schools. In some cases the class exercise and homework were hardly marked, or if marked feedback was hardly given to learners to improve learning. These findings confirm Markie's et al. (2013) study who contend that the two-level structural equation models affected instructional quality that equally affected learners' performances. In the case of instructional quality, the type and quality of learners work will negatively affect the attainment of high-level learners' performances in mathematics. It is thus not surprising to find that the business mathematics at the tertiary level is one of the gatekeeper courses.

### **5.1 Limitation of the study**

The outcome of this study would have carry more weight if the sample of teachers were drawn according to the qualification, gender, teaching experience, region, and location of the school using stratified sampling technique firstly and later randomly. This would have enabled the researchers to draw an appropriate generalization of the findings to the population.

Secondly, teachers were not examined according to various levels of qualifications, teaching experiences, region, two gender groups of male and female and location of the school into three levels namely rural-urban and semi-urban.

As such, it was not possible to determine for example, which level of qualification, experience, region, gender or school location, exerted effects on teachers' competencies in teaching mathematics. Thus, it was not possible to conclude which qualification, teaching experience, region, gender group or location exerted effect on teaching competencies.

A trained mathematics teacher who was a member of the research team did the classroom observations. The remaining researchers assessed the classroom document as stipulated in the classroom observation form. This was a denting and exhausting task especially to the researchers and could have negative implications on the study outcomes.

## **5.2 Conclusion and policy implications**

This study used the National External Schools Evaluation, Classroom Observation Instrument 4A. The instrument was used to assess and evaluate classroom practices for promotional subjects in Namibian schools. Thus, the determinants of lesson plan and preparations are determined by teachers' qualification and region where teachers resided and slightly teaching experience. On competencies in lesson planning the determinants were field of study, slightly qualification, and region. Interestingly, the competencies in teaching strategies were determined by the field of study and gender. Further, gender and slightly teaching experience and field of study determined competencies in availing mathematics teaching materials. On assessment and evaluation of learners, the determinants were a field of study followed by region, while the field of study and slightly region where teachers reside, determined the teachers' competencies in providing the type and quality of learners' work. These propositions aligned heavily to content knowledge and pedagogical content knowledge. A combination of mathematics and pedagogic knowledge of business finance is essential for improving the outcomes of business mathematics course among the business management students. Students who are competent in mathematics are marketable in the industry and are easily absorbed.

These findings have various policy implications to Namibia. The mere fact that field of study determines the mathematics teacher's competencies in lesson planning and preparation, teaching strategies, assessment and evaluation, provision of quality types of learners' work, implies that allocating teachers with an appropriate field of study and qualification in schools will improve mathematics outcomes. Thus, the Namibian Ministry of Education should ensure schools strictly follow the appropriate policies regarding allocation of teaching periods according to field of study and qualification. The Influence exerted by region on assessment and evaluation of learners, lesson planning implies that regions are not equally administered. Regional managers specifically school inspectors, should ensure that appropriate staffing norm is implemented. School managers tasked to monitoring teaching and learning should ensure that teachers' placement and allocation to subjects according to the field of specialization and qualification. On provision of teaching materials, school managers need to monitor the provision of teaching materials in order enhance teaching and learning. Where possible, in absence of commercial teaching materials, teachers should improvise and use the surrounding local sources to develop teaching materials.

Finally the results of this study emphasise the essence of Shulmans' theory regarding teacher content and pedagogical knowledge competencies, of which the three forms of knowledge, namely, propositional knowledge, case knowledge and strategic knowledge were described. The three forms link profoundly to the assessed competencies contained in the classroom observation instrument and the determinants of teachers' competencies.

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