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Mathematics subject supervisors' role in ensuring quality teaching in preprimary and primary schools

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Background: The need to examine mathematics subject supervisors' roles in ensuring quality performance in mathematics learning is evident in the declining performance of learners in mathematics. This is attributed to various variables such as inadequate supervision, overcrowded classrooms, inadequate and obsolete resources, disillusioned teachers and poor pedagogical content knowledge. Hence, this study examines mathematics subject supervisors' roles in ensuring quality teaching in preprimary and primary schools.

Aim: This study aimed to enhance subject supervisors' role in ensuring quality teaching in preprimary and primary school mathematics.

Setting: Public preprimary and primary schools in the Owerri Educational Zone of Imo State, Nigeria, served as the research setting.

Methods: The research adopted the quantitative research method and a descriptive survey research design. Questionnaires were used as the instruments for data collection and were validated by experts in mathematics education. The instruments' reliability coefficients of 0.83 and 0.78 were determined using the Cronbach's alpha reliability method. The generated data were analysed using four-point Likert scales, means and standard deviations.

Results: The results showed that mathematics subject supervisors did enhance quality teaching in mathematics, although they were not effective in developing communities of practice among teachers. Furthermore, both mathematics teachers and mathematics subject supervisors faced challenges of inadequate learning resources, low teacher morale, insufficient professional development, low learner motivation for mathematics and poor learning infrastructure.

Conclusion: The researchers recommend developing a community of practice among teachers and organising competitions among learners as a panacea to enhance desirable qualities in preprimary and primary mathematics teaching.

Keywords: Mathematics subject supervisors; preprimary and primary school mathematics teachers; mathematics teaching and learning; community of practice; developmental supervision.

Introduction

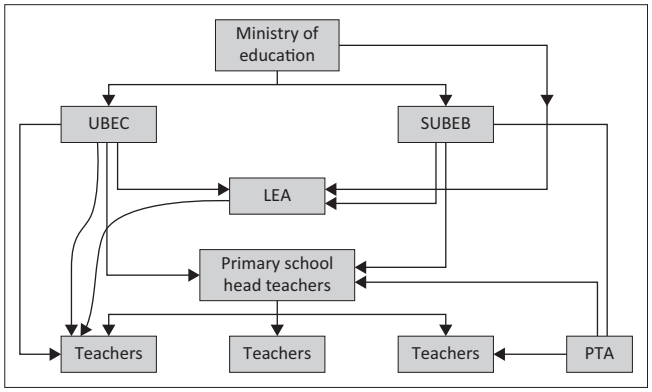
School mathematics leaders play a significant role in improving the outcomes of mathematics teaching and learning. They are often ordinary teachers who take on the added responsibility of executing leadership activities in strengthening mathematics instruction in schools. Their roles include supporting teachers in strengthening their pedagogical content knowledge (Gaffney, Bezzina & Branson 2014) and creating opportunities to engage in professional development activities alongside other teachers (Sexton & Downton 2014). Subject leaders have also been referred to by other terms, such as coaches, numeracy coordinators and specialist teachers (Driscoll 2017). In Nigeria, subject leaders are referred to as instructional supervisors or subject supervisors, tasked with 'guidance, assistance, idea sharing, facilitation, … to assist teachers in improving the learning situation and quality of learning in schools' (Basilio 2021:2). In this study, the nomenclatures instructional supervisors and subject supervisors are used interchangeably.

In countries such as South Africa, Ethiopia, Kenya, Zimbabwe and Uganda, the Department of Education makes provisions for subject supervisors as an integral arm of the education system (Muthala et al. 2022; Vurayai & Muwaniki 2016). For example, in Kenya, it was uncovered that

supervision significantly improved the quality of teaching and learning (Wanzare 2012). However, the Nigerian Ministry of Education mechanism does not provide for school subject supervisors, as seen in the primary school organogram and management in Figure 1 (Igbineweka & Anukaenyi 2016). Instead, the Ministry of Education provides for local school inspectors, who visit the schools occasionally with mainly an oversight role and are not necessarily expected to supervise and support academic activities. Furthermore, supervision of academic activities in Nigerian preprimary and primary schools is left in the hands of the school head teachers.

Figure 1 explains the primary school organogram and its management. The Ministry of Education relates directly to the Universal Basic Education Commission (UBEC) and the State Universal Basic Education Board (SUBEB). The UBEC and SUBEB work directly with the Local Education Authority (LEA) and the primary school head teachers. The head teachers work directly with their classroom teachers and the Parent–Teacher Association (PTA). It is also the head teacher's administrative duty to work collaboratively with the host community in which the school is situated.

Consequently, the daily administration of preprimary and primary schools in Nigeria lies within the head teacher's office. Hence, the leading role of the head teacher is to have direct administrative oversight of the teachers and learners. While they are tasked with ensuring quality academic programmes, including mathematics, they may not be deeply knowledgeable in all the subjects taught in the school, because most of the head teachers are generalists and not specialists in teaching mathematics. Therefore, the appointment of specialists as mathematics subject supervisors becomes imperative for quality teaching and learning of the subject. This forms the basis for the head teachers to appoint subject supervisors from their teaching staff. In Nigerian primary schools, all teachers are expected to teach primary mathematics. However, the teacher with mathematics as an area of speciality is appointed the mathematics subject supervisor and is responsible for all teachers who teach mathematics in the school.



Source: Igbineweka, V.O. & Anukaenyi, M.B., 2016, 'Crisis in primary education management in Nigeria: Adopting the Fredrick Taylor theoretical model for crisis control', *International Journal of Educational Foundations and Management* 10(1), 176–184

LEA, Local Education Authority; UBEC, Universal Basic Education Commission; SUBEB, State Universal Basic Education Board; PTA, Parent–Teacher Association.

FIGURE 1: Organogram showing the organisation and management of primary education in Nigeria.

One of the major goals of primary education in Nigeria is to develop literacy, numeracy, communicative, scientific and critical thinking skills to function effectively in society and to serve as the foundations for higher levels of education (Federal Government Nigeria 2004). However, despite the government's efforts to improve the teaching and learning of mathematics, learner performance in mathematics remains an area of concern (Olanrewaju 2019). The poor performance of learners in examinations has been primarily attributed to inadequate learning facilities, such as overcrowded classrooms, obsolete equipment and disillusioned teachers (Izuagba, Afurobi & Jeremiah 2014). It is further attributed to inadequate supervision of instructional activities, a lack of effective teaching, teachers' laissez-faire attitude, learners' low motivation in the subject and teachers' poor remuneration, among others (Arop et al. 2020; Owadiae 2010). This has become a major concern to school administrators, the government and other stakeholders (Iroegbu & Etudor-Eyo 2016; Owadiae 2010). These views are not unique to Nigeria. For example, Alam, Haque and Banu's (2021) research in Bangladesh pointed to a lack of dedication and professionalism from teachers, together with weak supervision as factors that impacted the quality of education. These scholars further noted that if quality teaching and performance in education are to be achieved, school supervision needs to be integrated as a binding mechanism for ensuring that school policies, regulations, correct teaching approaches and educational goals and objectives are efficiently implemented. Unfortunately, the effective implementation of supervision is also plagued with challenges, ranging from inadequate supervision time, supervisors' professional incompetence and negative attitudes inhibiting quality instructional supervision in the educational system (Memduhoğlu & Zengin 2012). In support of Alam et al.'s (2021) views, Mandefro (2020) avows that supervision is critical in improving teaching and learning and empowering teachers for effective performance.

Against this backdrop of the many challenges that impact teaching and learning in Nigeria, researchers in this study sought to examine mathematics subject supervisors' contribution to ensuring quality performance in preprimary and primary school mathematics. The following research questions guided the study: (1) what supervisory roles do mathematics subject supervisors play to ensure quality mathematics teaching performance in Nigerian public preprimary and primary schools? (2) How do teachers perceive mathematics subject supervisors' supervisory roles in ensuring quality mathematics teaching performance in Nigerian public preprimary and primary schools? (3) What constraints do mathematics subject supervisors face in ensuring quality mathematics teaching performance in Nigerian public preprimary and primary schools?

Literature review

According to Greenes (2013), mathematics supervisors should have a deep understanding of the 'big ideas' in the

subject; mathematical concepts and methods of problem solving; and an understanding of online resources to extend teaching and learning besides the understanding of 'best practices in assessment, pedagogy, and professional development' (p. 45). Similarly, Mullis et al. (eds. 2016) identify six macro mathematics teaching and learning goals. These goals are as follows: (1) to generate interest in mathematics and promote a solid foundation for everyday life; (2) to develop computational thinking and problem-solving skills; (3) to develop the ability to recognise problems and solve them with related mathematical knowledge; (4) to develop precise, logical and abstract thinking; (5) to promote necessary mathematical background for further education; and (6) to stimulate and encourage creativity (eds. Mullis et al. 2016). In discussing the role and responsibilities of subject supervisors, this study draws on the goals as outlined by Mullis et al. (eds. 2016), as they are all encompassing in forming the bedrock for facilitating quality in mathematics teaching.

In addressing these goals, developmental supervision is considered an important approach in which meaningful professional interactions between practising novice teachers and their more knowledgeable expert colleagues can take place (Glickman, Gordan & Ross-Gordan 2014). Developmental supervision is uniquely characterised by the understanding that teachers' competencies, aptitudes, understanding and effectiveness vary, requiring a distinctive supervisory approach that meets teachers' individual needs (Strieker et al., 2016). Subject supervisors do not work as authoritative agents who threaten teachers but as trusted fellows to improve teachers' performance in the classroom (Hoque 2020; Owusu 2020). Developmental supervisors are colleagues, helpers, motivators and facilitators who must adopt a collegial, cooperative and nondirective supervisory approach toward practising teachers. Such practising teachers are said to progress from self-regulated to self-directed in their teaching and learning processes. Such supervisors are thus more democratic than commanding, more teacher-centred than supervisor-centred, more concrete than vague, more objective than subjective and more focused than unsystematic (Glickman et al. 2014). Glickman et al. (2014) assert that supervisors who adopt a developmental supervisory approach in the supervision of practising teachers can respond to teachers' needs as individuals and as groups.

Using a nondirective supervisory approach for practising teachers creates interdependency between teachers and supervisors. It helps teachers establish professional goals, create self-improvement plans, monitor progress and think critically about teaching and learning (Glickman et al. 2014). According to Smith (2009), for:

> [*S*]upervisors who employ a developmental approach to supervision, the key is to accurately identify the supervisee's current stage and provide feedback and support appropriate to that developmental stage, while at the same time facilitating the supervisee's progression to the next stage. (p. 3)

In the past, instructional supervision took the form of inspection of teachers' tasks. The inspectory approach was entrenched in 'controlling' rather than 'developing' a teacher's capacity (Glickman et al. 2014). With the inspectory approach, teachers become knowledgeable about their areas of instructional weakness without understanding how to develop for improvement in such areas (Glickman et al. 2014). This is the premise that gave rise to guided supervision. Guided supervision allowed teachers to know 'what' to do when discharging their tasks; however, it made some teachers more dependent on their supervisors (Glickman et al. 2014). Considering that teachers operate at different levels of professional development, background and personal experience, developmental supervision became a panacea for teachers to improve and enhance their teaching skills without depending on their supervisors.

A developmental supervisory approach is important when one considers that a large percentage of educators teaching mathematics, especially in the early years of schooling, are not specialists in the subject they are teaching (Bot & Caleb 2014; Karvinen-Niinikoski 2016). Mathematics is one of the subjects in which learners underperform, hence the need to identify and remove barriers to teaching at all school levels, including at the preprimary and primary school levels (Awofala 2017). Research has shown that inadequately qualified teachers in primary and postprimary Nigerian schools threaten quality learning (Bot & Caleb 2014). In their research, Bot and Caleb (2014) revealed that 83 mathematics teachers were responsible for teaching mathematics to 19 323 mathematics learners in some selected regions of Jos, Plateau State, Nigeria. The teacher–learner ratio was 1:233. Meanwhile, the national policy on education recommends a 1:35 teacher–learner ratio (Federal Government of Nigeria 2004). As such, the quality of mathematics teaching and learning remains questionable because of insufficient human resources. In the findings of Bot and Caleb (2014), the research uncovered some schools that do not have mathematics teachers and many schools that have just one mathematics teacher, while a few have between 2 and 4 teachers. A review of the quality of mathematics teachers in Nigeria also cannot be disconnected from the national policy of education. According to the national policy on education in Nigeria, the minimum requirement to become a professional teacher is the Nigeria Certificate in Education (NCE), besides other qualifications such as a Bachelor of Education (BEd), Bachelor of Science (BSc), Master of Education (MEd) and a maximum of Doctor of Philosophy (PhD) (Federal Government of Nigeria 2004). In 2016, Dada and Yusuf (2016:59) conducted research to determine the impact of teachers' qualifications and experience on students' performance in colleges of education and discovered that learners taught by professionals performed better than nonprofessionals. Their research implied that teachers with teaching qualifications perform better in classrooms.

To this end, one of the tools for ensuring quality in the education system, such as instructional supervision, must be

strengthened to improve mathematics teaching and learning (Early Childhood Education 2016; Steinhardt et al. 2017). Instructional supervision can take the form of monitoring the quality of assessments and providing guidance on areas of need. Assessment is important in determining the learner's prior knowledge and understanding of new concepts and addressing misconceptions (Darling-Hammond 2020). From a mathematics supervisor's perspective, monitoring both formative and summative assessments is important. It would also mean providing support and development on best practices in assessment, choice of learner activities that address the lesson outcomes and big ideas as well as choice of appropriate pedagogies (Greenes 2013). In monitoring the quality of mathematics teaching and learning, Nigerian mathematics subject supervisors need to be able to conduct qualitative observations in the classroom. Qualitative observation entails assessing the mathematics learning environment and how it impacts learning (Ekeh & Venketsamy 2021; Malik & Rizvi 2018). The environments wherein learners learn can significantly impact learners' academic achievement, with poor learning environments negatively impacting learning outcomes (Malik & Rizvi 2018).

Next, the supervisor should examine the efficacy of the teacher's instructional methods in assessing the quality of mathematics teaching and learning (Nwachukwu & Ogudo 2014), which implies determining whether the teaching and learning materials selected by the teacher are suitable, as the materials used can enhance learning (Izuagba et al. 2014). Any educational resources that facilitate mathematics teaching must be learner friendly, age appropriate and integrate feedback in the learning process (Wang et al. 2010). Furthermore, Wahyu (2020) mentions that the supervisor should assess whether the instructional strategy (1) is age appropriate; (2) takes into account different learners' abilities, as mathematics classes in Nigeria are of the mixed-ability type (Lochmiller 2016); (3) allows for developmental thinking, creativity and resourcefulness; and (4) delivers appropriate sequencing of the instructional modes that facilitate meaningful learning of mathematics. Furthermore, on the supervision of instructional activities, several researchers have argued in favour of instructional supervision, noting that it is among the academic activities that ensure quality education performance. In 2016, Oke examined how instructional supervision relates to caregiver performance in Federal Capital Territory, Abuja, Nigeria. Oke (2016) discovered that 'adequate supervision in early childhood education assists caregivers in acquiring new skills; helps inexperienced caregivers acquire a new method of teaching and helps them identify children with learning impairment' (Oke 2016:2682). In other research, Archibong (2021) revealed the efficacy of instructional supervision in improving the quality of education. Archibong (2021) noted that supervisors used supervisory techniques such as classroom observation, teacher visitation, demonstration, workshop, microteaching, listening to recordings and guided practice as means of instructional supervision.

Integrating feedback into teaching and learning is a beneficial approach to learners' gaining maximum proficiency in any subject. For instance, Ion, Sánchez Martí and Agud Morell (2019) researched the benefits of giving and receiving feedback and revealed that students had better learning experiences as they developed cognitive and metacognitive, affective and professional competencies through feedback. Similarly, there was a positive indication that students benefited more in their learning through an online peer assessment on giving and receiving feedback activity (Lochmiller 2016). Feedback is therefore an authentic instrument for achieving and maximising learning gains. Correspondingly, the supervisor determines whether the teacher provides adequate feedback to learners. The feedback systems allow the teacher to clarify the processes and ideas taught in the mathematics class, thus improving quality learning (Lochmiller 2016).

The actualisation of any educational objectives (mathematics included) hinges on the learning process through a continuous reconstruction of and reflection on the learning experience. This requires working together to find solutions to problems in the classroom. Working collaboratively to find solutions to existing educational problems is capsulated into the idea of a community of practice. There is no single definition of community of practice, as it is interpreted differently depending on various situations and organisations. Wenger, McDermott and Snyder (2002) considered a community of practice to be a group of people who share a concern, a set of problems or a passion about a topic and deepen their knowledge and expertise in an area of interest. The definition of community of practice shifted the notion, which was focused on individual learning and identity, to one that concerns the development, management and improvement of workers' knowledge (Wenger et al. 2002). This paradigm shift in the concept of community of practice spurred workers to work as teams and groups to share their individual knowledge, leading to the emergence of communities of practice found in many organisations today. Li et al. (2009) noted that communities of practice also provide support to their members, facilitate interactions among members of the same community, create a conducive environment for the sharing of knowledge and build a sense of belonging among team members. The authors are, however, cognisant that successful collaboration is dependent on individuals' attitudes and on how conflict pertaining to differences in ideas about how children learn is addressed (Wilhelm 2017). It is therefore important for mathematics subject supervisors to address possible challenges when developing and promoting communities of practice among teachers. The need for supervisors to set up communities of practice among teachers cannot be overemphasised, as this will positively impact the quality of teaching and learning.

Methodology

The researchers used the quantitative research method framed as a descriptive survey design. As explained by Creswell (2009), a descriptive survey provides a numeric

description of the trends, views and attitudes of a sample of that population. A descriptive survey design is considered appropriate because it involves systematic and objective means for data collection and analysis.

The simple random sampling technique was used to draw a sample from all mathematics subject supervisors and mathematics teachers in the 254 public preprimary and primary schools in the Owerri Educational Zone of Imo State. The total sampled population size of the study was 110 participants (comprising 24 mathematics subject supervisors, 21 preprimary mathematics teachers and 65 primary school mathematics teachers). This sample size was deemed sufficient to address the research objectives as it related to a specific Education Zone of Imo State. The study took place within the last 2 weeks of February 2022.

The researchers developed the instruments used in a set of two short, self-administered questionnaires for data collection, which were titled the Mathematics Subject Supervisors Questionnaire (MSSTQ) and the Mathematics Teachers Questionnaire (MTQ). The questionnaires addressed the objectives of the study and incorporated some aspects from the macro mathematics teaching and learning goals as outlined by Mullis et al. (eds. 2016). The questionnaires were structured using a modified four-point Likert-type scale with Strongly Agree (SA), 4 points; Agree (A), 3 points; Disagree (D), 2 points; and Strongly Disagree (SD), 1 point. For any item to be considered agreed to, the mean score had to be above the benchmark mean of 2.50, while any mean less than 2.50 constituted disagreement with the statement. The benchmark mean of 2.50 was arrived at by adding (SA – 4), (A – 3), (D – 2), and (SD – 1) and dividing the sum by 4. The tool used in analysing the data was the Statistical Package for the Social Sciences (SPSS) version 20.0 software (IBM Corporation, Armonk, New York, United States), because the software works well with survey analysis. Three experts in mathematics education determined the instruments' validity. A trial test was carried out on mathematics subject supervisors and teachers outside the study sample to establish the Cronbach's alpha reliability coefficients of 0.83 and 0.78. Generally, a reliability coefficient is considered acceptable if Cronbach's alpha values are between 0.70 and 0.95 (Stockemer 2019).

The Faculty of Education ethics committee of the University of Johannesburg approved the ethics for the study and participants provided written consent to participate.

Data analysis, results and findings

A detailed discussion of the analysed data is presented in the subsequent paragraphs beneath each research question and data table. Thereafter, the study's findings are discussed, and recommendations are made.

Research question 1

What supervisory roles do mathematics subject supervisors perform to ensure quality mathematics teaching performance in Nigerian public preprimary and primary schools?

Mathematics subject supervisors responded to the items in Table 1. The responses show that mathematics subject supervisors monitor mathematics teachers' lesson plans and teaching resources, as evident in the mean scores of 3.56 and 3.33, respectively. The mean score of 3.25 shows that subject supervisors do perceive themselves to observe teachers' pedagogical approaches to mathematics teaching. Subject supervisors considered themselves to be organising mathematics teachers' communities of practice to enhance teaching performance, with this question resulting in a mean of 3.04. Supervisors agreed (mean level 3.27) that they established effective feedback communication channels for teachers and learners. Furthermore, subject supervisors considered that they motivated teachers to attend professional development programmes such as mathematics conferences, as indicated by a 3.58 mean. The only item whose 2.50 benchmark was not met related to subject supervisors organising mathematics competitions among learners through their mathematics teachers, which had a mean of 2.46.

Therefore, the findings confirm that mathematics supervisors undertake the above supervisory roles except for organising mathematics competitions among learners through their mathematics teachers. This is unfortunate as the use of mathematics competitions is a veritable tool for teachers to boost learners' interest in mathematics (Owadiae 2010).

TABLE 1: Mean and standard deviation of mathematics subject supervisors' supervisory roles.

SN	Items	SA	A	D	SD	$\bar{x}$	σ	Remarks
1	A regular check of mathematics teachers' lesson plans	13	10	-	-	3.57	0.645	Agreed
2	A regular check of mathematics teachers' teaching resources	9	14	1	-	3.33	0.568	Agreed
3	Observing teachers' pedagogical approach to mathematics teaching during lessons	8	14	2	-	3.25	0.550	Agreed
4	Organising mathematics teachers' community of practice to enhance teaching and learning	8	9	7	-	3.04	0.257	Agreed
5	Establishing effective feedback communication channels for teachers and learners	8	12	2	-	3.27	0.335	Agreed
6	Motivating teachers to attend professional development programmes such as mathematics conferences	18	3	2	1	3.58	0.635	Agreed
7	Organising mathematics competitions among learners through their mathematics teachers	2	7	12	3	2.46	0.457	Disagreed

SN, statement number; SA, strongly agree; A, agree; D, disagree; SD, strongly disagree.

Research question 2

How do teachers perceive mathematics subject supervisors' supervisory roles in ensuring quality mathematics teaching performance in Nigerian public preprimary and primary schools?

Results in Table 2 represent responses from mathematics teachers and indicate that only two items (4 and 7) received a score below the mean benchmark of 2.50, being 1.80 and 1.68, respectively. This implies that mathematics teachers perceived subject supervisors to be effective in regularly checking their lesson plans and teaching resources and motivating teachers to attend professional development sessions such as conferences. Furthermore, subject supervisors were viewed as professional in observing teachers' pedagogical approaches to mathematics teaching in class and actively establishing effective feedback communication channels for teachers and learners. These findings thus demonstrate compliance with Wahyu's (2020) assertion that supervisors should be professional in planning, organising, leading, assessing and giving feedback. Important here is that the subject supervisor, who is also a classroom teacher, takes a developmental supervisory approach by checking lesson plans and providing feedback for improvement. To some extent, the subject supervisor not only leads mathematics in the school but also serves as a voice for teachers (Higgins & Bonne 2011). This voice is important in ensuring that teachers receive adequate resources and development in areas of pedagogy.

A comparison of responses in Table 1 and Table 2 indicates that contrary to mathematics supervisors' assertion that they do organise communities of practice among mathematics teachers, mathematics teachers noted that mathematics subject supervisors were ineffective in organising communities of practice. Teachers' responses affirm the assertion of McDonald and Cater-Steel (eds. 2016) that communities of practice are not encouraged in developing countries because of the relatively higher teacher workload and the lack of interest by teachers, who want to leave schools as soon as the school day ends. However, the need for mathematics professional development cannot be overemphasised, because it allows teachers the opportunity to interchange mathematical ideas among themselves, thereby stimulating innovation and creativity. On the other hand, collaboration can also address misconceptions about teachers' understandings of mathematical concepts. This is important, especially when one considers that a large percentage of educators teaching mathematics, especially in the early years of schooling, are not specialists in the subject teaching (Bot & Caleb 2014). Cultivating communities of practice among practitioners helps their growth and professional development (Wenger et al. 2002). Subject supervisors have an important role to play in creating an environment that encourages collaboration and self-reflection. Spaces need to be created where teachers feel safe and trusted to exchange ideas and experiment with their pedagogy (Childs, Burn & McNicholl 2013).

In contrast to the disagreement concerning communities of practice, mathematics teachers' opinions that supervisors are not a motivating catalyst in organising mathematics competitions among learners through their teachers correspond with supervisors' perspectives in this regard. Participation in mathematics competitions is an attempt to motivate learners in the subject and is linked to developing student's self-efficacy. By participating in competitions, they exhibit confidence in their mathematical problem-solving abilities (Schoenfeld 2013).

The overall findings from the data in Table 2 are thus that teachers perceive mathematics supervisors to be dutiful in fulfilling their supervisory roles except for (1) organising communities of practice among mathematics teachers and (2) organising mathematics competitions among learners through their teachers. Ngwenya (2020) argues that supervisors should create avenues for mathematics teachers to acquire sound mathematics knowledge, which is not carried out within the Owerri Educational Zone.

TABLE 2: Mean and standard deviation on mathematics teachers' perception of mathematics subject supervisors' supervisory activities.

SN	Items	SA	A	D	SD	$\bar{x}$	σ	Remarks
1	Mathematics teachers perceive subject supervisors to be effective in regularly checking on their lesson plans.	40	42	3	-	3.44	0.412	Agreed
2	Mathematics teachers perceive subject supervisors to be effective in regularly checking their teaching resources.	42	33	9	1	3.36	0.306	Agreed
3	Mathematics teachers perceive subject supervisors to be professional in observing teachers' pedagogical approach to mathematics teaching during lessons.	33	36	13	1	3.22	0.292	Agreed
4	Mathematics teachers do not perceive subject supervisors to effectively organise mathematics teachers' community of practice to enhance teaching performance.	39	29	12	5	1.80	0.286	Disagreed
5	Mathematics teachers perceive subject supervisors to be active in establishing effective feedback communication channels for teachers and learners.	33	36	12	3	3.18	0.286	Agreed
6	Mathematics teachers perceive subject supervisors to be enthusiastic in motivating teachers to attend professional development programmes such as mathematics conferences.	58	13	11	4	3.45	0.316	Agreed
7	Mathematics teachers do not perceive subject supervisors as a motivating catalyst in organising mathematics competitions among learners through their mathematics teachers	35	44	4	2	1.68	0.301	Disagreed

SN, statement number; SA, strongly agree; A, agree; D, disagree; SD, strongly disagree.

Research question 3

What constraints do mathematics subject supervisors face in ensuring quality mathematics teaching performance in Nigerian public preprimary and primary schools?

Mathematics supervisors and mathematics teachers responded to items in Table 3 and Table 4. The challenges faced by mathematics subject supervisors and mathematics teachers were evident, as shown in Table 3 and Table 4. Respondents agreed with all the statements, as their mean scores exceeded the 2.50 mean benchmark. This implies that supervisors face challenges of inadequate cooperation among mathematics teachers, inadequate learning resources, low mathematics teacher morale, inadequate professional development, low learner motivation for mathematics, poor learning infrastructure and examination malpractice such as learners copying answers from one another.

The data in Table 3 and Table 4 show that the physical and psychosocial learning environments of the schools under study are poor. This finding corroborates those of Ekeh and Venketsamy (2021) and Izuagba et al. (2014), who argue that most Nigerian learning environments are not learner-friendly and conducive to learning. The authors concur with Sievert et al. (2019) on the importance of relevant teaching and learning resources in framing how mathematics teachers design learning activities and in providing opportunities to develop adaptive expertise in strategies used to teach. In describing adaptive expertise specific to mathematics teaching and learning, the following explanation by Selter (2009) is found useful:

> Adaptivity is the ability to creatively develop or to flexibly select and use an appropriate solution strategy in a (un)conscious way on a given mathematical item or problem, for a given individual, in a given sociocultural context. (p. 624)

In addition to having a deep understanding of the subject and pedagogies to teach mathematics, context is important (Selter 2009), which can either advance or constrain teachers' flexibility and choices in selecting appropriate strategies to teach. Environments that are not conducive to learning impact negatively on teacher morale and on learner motivation, as supported by the data.

Inevitably, poor quality physical and psychosocial learning environments contribute to poor teaching and learning. Izuagba et al. (2014) noted a considerable deficit in the quality of teaching and learning resulting from overcrowded classrooms, inadequate and obsolete equipment and disillusioned teachers. Furthermore, Owadiae (2010) and Ayeni and Ibukun (2013) found that the poor performance of learners in examinations is primarily attributable to inadequate learning facilities and supervision. The researchers make the following recommendations.

Recommendations

Among the recommendations made for this study are that mathematics subject supervisors, as well as head teachers, should regularly organise communities of practice among mathematics teachers so that they can share challenges and best practices. Improving teacher morale and learner motivation is key, and innovative ways of developing and inculcating positive attitudes towards the subject should be explored. Next is the provision of adequate resources and ensuring that learning environments are conducive to learning, as they impact the effectiveness of supervision aimed at improving mathematics teaching and learning. The Nigerian government and school management should provide adequate funding for teachers' professional development and learning resources for mathematics and upgrade learning infrastructure to help curb overcrowding, leading to examination malpractice (learners copying answers from one another).

Conclusion

The study set out to determine whether Nigerian preprimary and primary school mathematics subject

TABLE 3: Mean and standard deviation on constraints faced by mathematics subject supervisors (mathematics supervisors' perspectives).

SN	Items	SA	A	D	SD	$\bar{x}$	σ	Remarks
1	Inadequate cooperation among mathematics teachers	5	8	5	4	2.64	0.48	Agreed
2	Inadequate mathematics learning resources	10	9	4	-	3.26	0.564	Agreed
3	Low mathematics teacher morale	5	10	4	3	2.77	0.49	Agreed
4	Inadequate professional development	5	13	4	-	3.05	0.531	Agreed
5	Low learner motivation for mathematics	6	7	6	3	2.72	0.486	Agreed
6	Poor learning infrastructure	8	10	4	1	3.09	0.527	Agreed
7	Examination malpractice; copying answers among learners	10	8	4	1	3.17	0.544	Agreed

SN, statement number; SA, strongly agree; A, agree; D, disagree; SD, strongly disagree.

TABLE 4: Mean and standard deviation on constraints faced by mathematics subject supervisors (mathematics teachers' perspectives).

SN	Items	SA	A	D	SD	$\bar{x}$	σ	Remarks
1	Inadequate cooperation among mathematics teachers	32	20	21	10	2.89	0.26	Agreed
2	Inadequate mathematics learning resources	51	25	5	3	3.48	0.324	Agreed
3	Low mathematics teacher morale	31	39	10	5	3.13	0.278	Agreed
4	Inadequate professional development	36	32	9	7	3.15	0.282	Agreed
5	Low learner motivation for mathematics	33	30	11	11	3.00	0.266	Agreed
6	Poor learning infrastructure	51	26	7	2	3.47	0.319	Agreed
7	Examination malpractice; copying answers among learners	45	26	8	3	3.38	0.314	Agreed

SN, statement number; SA, strongly agree; A, agree; D, disagree; SD, strongly disagree.

supervisors provided quality mathematics teaching and learning. Using a quantitative design, the researchers drew on variables that they could measure to conduct a statistical analysis of the relationships between these variables. From the analysis, the researchers discovered that whereas mathematics subject supervisors try to ensure quality output in mathematics teaching and learning, there were a number of challenges. These include inadequate communities of practice within the school environment, limited access to resources and low morale and motivation from both teachers and learners. Emotion cannot be separated from teaching and learning (Dehaene 2020), and thus creating an emotionally positive classroom environment that is conducive to teaching and learning is key. While it is acknowledged that the subject supervisors, who are also teachers in the school, have limited authority to make decisions, it can be argued that they are an important voice for the teachers as they experience first-hand the effects of these challenges on teaching and learning. However, this study recognises the importance of adopting a developmental supervisory approach by subject supervisors in guiding teachers in lesson design and when observing teaching. For future research, a qualitative study can be conducted to explore the relationships between the variables in greater depth.

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Competing interests

The authors have declared that no competing interest exists.

Authors' contributions

M.C.E. contributed to the writing, conceptualisation, methodology, analysis and field investigation, while S.R. contributed to the supervision, editing, review and editing and funding of the manuscript.

Ethical considerations

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Data availability

The data for this research are available and will be uploaded as part of the supplementary files.

Disclaimer

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