

Secondary School Principals' Perceptions and Support of Professional Development for Science and Mathematics Teachers in Zamfara State, Nigeria

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Abstract: This qualitative study sought to find out the perspectives of secondary school principals regarding their roles in organizing school-based professional development activities for science and mathematics teachers and the related challenges at school level in Zamfara State, Nigeria. Twenty secondary school principals were purposively sampled for the study from the four educational zones in the state. Collection of data was done through structured interviews, and data obtained were analyzed through content analysis. The findings of the study revealed that despite the crucial role of principals in promoting professional development, the majority of them do not fulfill their role optimally in this respect. Professional development activities organized by few principals are limited to workshops and seminars, and there are not sustained as ongoing opportunities. Challenges faced by principals in organizing school-based professional development include inadequate funding, lack of support from higher authorities, inadequate training of principals, and lack of motivation among teachers. The study concluded that, the poor involvement of principals in promoting professional development has significant implications on the quality of teaching and learning of science and mathematics in Zamfara State. The study recommends that government and education stakeholders provide adequate funding and support to principals to enable them organize sustainable and relevant professional development activities for teachers. Additionally, training and motivation programmes should be developed for principals to enhance their capacity in promoting professional development among teachers.

Keywords: Professional development, science teachers, mathematics teachers, secondary schools, principals.

INTRODUCTION

Secondary school is crucial level of education in the Nigerian educational system. This is because, it provides basic education such as literacy, numeracy and effective communication skills, and tertiary education is heavily reliant on secondary education as a feeder to the Nigerian tertiary education system (Umar *et al.*, 2021). Therefore, it serves as a bridge between the primary and tertiary levels of education. Tracing the history of teaching science and mathematics in secondary schools in the early 21st century reveals that, knowledge of science and mathematics are justified on the basis of their relevance to modern life and their contribution to a shared understanding of the world. Hence, science and mathematics teachers at secondary school level are invariably key to the national development.

However, the role and expectations of science and mathematics teachers keeps changing (Isma'il & Cyril, 2022). They are faced with emerging challenges of teaching in increasingly diverse classrooms that

requires placing greater emphasis on different learning needs of students. This situation necessitates ongoing teacher retraining in order for them to be equipped with new knowledge and skills to face emerging challenges and reforms in education, as this will allow them to improve their efficiency, ability, knowledge, and motivation in their professional work (Olujuwon & Omiyale, 2021). In recognition of these facts, Nigeria formulated a policy on education (Federal Republic of Nigeria [FRN], 2013), therein, it clearly seeks to provide teachers with opportunities for professional development. The FRN (2013) stated that "in-service training shall be an integral part of continuing teacher education...Promotion opportunities shall continue to be created for unhindered professional growth at all levels". This was spelt out in bid to maintain a high standard of teaching and to retain a high-quality teacher workforce. The policy, made it mandatory for all school proprietors or employers to provide professional development for their teachers.

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In recent literature, the term professional development is frequently used interchangeably with terms like staff development, in-service or skills training, and continuing education (Sodangi *et al.*, 2022). Similarly, Eboka and Mbanefo (2022) also expressed that, professional development for teachers is described in different ways such as; human capacity development, human capacity building, human resource development and human empowerment. Sodangi *et al.*, (2022) defined professional development as provision of learning, development and training opportunities for teachers in order to improve their organizational performance. According to Acuña and Ancho (2022), the relevance of teachers' professional development has been widely recognized and contributed successfully to educational processes. It is a learning opportunity that engages teachers' creative and reflective capacities to strengthen their practice. Sodangi *et al.*, (2022) stated that, "the main aim of professional development is to impact teachers' knowledge, skills, and beliefs, making their practice become more useful to their students" (p. 38). It provides teachers with the opportunity to gain additional competencies and qualifications in order to successfully perform their teaching duties (Egboka, 2018). Professional development inspires confidence in the teaching profession, thereby advancing teachers' careers (Egboka, 2018).

Through professional development engagement, teachers gain deeper understanding of their content knowledge and pedagogical skills to improve their teaching practices. Thus, professional development for science 'and mathematics teachers' is a veritable tool for sustaining educational growth and impact (Okafor *et al.*, 2021). For effective instructional delivery in secondary schools, Kotirde and Yunos (2014) suggested that, greater emphasis should be placed on teacher's professional development within a school developmental/improvement strategy. More so, the ever-increasing demand for quality instructional delivery necessitates professional competencies on the part of teachers (Egboka, 2018). Therefore, every science 'and mathematics teacher', both new and experienced, requires training at some point in order to improve their performance (Eboka & Mbanefo, 2022). This buttressed the assertion of Sodangi *et al.*, (2022) that, to effectively manage the dynamic demands of students, science and mathematics teachers require rigorous and continuous re-training through various forms of professional development not only outside but also within school level.

According to Okafor *et al.*, (2021), one of the main reasons for the neglect of professional development for teachers in Nigeria is lack of good educational leadership by school administrators. Greitāns *et al.*, (2021) contended that, school administrator plays a key role in the provision and organizing professional development for teachers. Particularly, school principals have been vested with the

responsibility of a manager or administrator in the helm of secondary education affairs. Hence, Achimugu and Obaka (2011) argued that, principal is both administrative and instructional leader. Arikewuyo (2007) stated that, the responsibilities enshrined for school principals portend a wide range of demands and challenges. It also indicated a multiple roles a principal is expected to fulfill. Among the functions of a school principal, organizing staff development in a secondary school environment is of particular interest to this study. The leadership of school principals in the area of teacher professional development is critical to the success of a school learning community (Paul, 2000). Professional development for teachers is the responsibility of school administrators (Koonce *et al.*, 2019). Similarly, Egboka (2018) stated that, being the chief executive officer at the secondary school level, principal is responsible for stimulating the available human and nonhuman resources to ensure quality output. Hence, principal occupied a unique position to influence the implementation of guiding principles to affect the overall quality of teachers' professional development.

Therefore, Umar *et al.*, (2021) regarded principal as the chief accounting officer, whose responsibilities include school management, administration, and curriculum and instructional development leadership. According to Westberry and Horner (2022), principal is second only to the teacher in terms of impact on student learning. Hence, principal's role in improving the effectiveness of teaching science and mathematics through provision of professional development at school level cannot be underestimated. As a leader, principal influences achievement by providing and ensuring efficient management of necessary resources for teaching and learning (Achimugu & Obaka, 2011). They play an important role in ensuring effective teaching and learning as well as curriculum and capacity development (Bada *et al.*, 2020). Umar *et al.*, (2021) emphasized that secondary school principals must be able to identify and promote teachers' professional development needs, as well as ensuring that teachers are properly trained to support secondary schools in becoming centers of excellence.

Kotirde and Yunos (2014) identified principal's leadership behaviour as one of reasons that contribute to low level of teachers' performance in secondary schools in Nigeria. Principals need to have or acquire features of leadership to enable them carry their teachers along (Ikenga & Ogbaga, 2021). However, one of the principals' challenges according to Ikenga and Ogbaga (2021) is to support teachers to improve students' outcome. They further stated that, "lack of cordial relationship between principals and teachers may significantly contribute to low academic performance of the student" (p. 64). This implies that, the principal's leadership capacity, quality and style of leadership influences the teaching and learning of

science and mathematics in schools.

It is therefore imperative that, school principals should provide efficient management processes and the required resources for teaching and learning for improved students' performance. Olujuwon and Omiyale (2021) affirmed that, appropriate and timely professional development has a positive effect on teachers and contributes to students' academic improvement. Egboka (2018) highlighted that, principal is responsible for providing management support practices in the area of teacher training and re-training so that teachers can perform their instructional delivery tasks professionally. To this end, Acuña and Ancho (2022) argued that, the role of a principal in teacher professional development cannot be disputed that it has the wider influence in helping teachers to achieve their professional competence.

However, despite the fact that discussions and interactions between principals and teachers about school-related issues are common in the school system (Kotirde & Yunos, 2014), yet, research findings have revealed that there is a significant gap between what teachers receive in the form of professional development and what they hope to receive (Sodangi *et al.*, 2022; Westberry & Horner, 2022). For instance, Sodangi *et al.*, (2022) reported lack of principals' support for science and mathematics teachers' professional development in Zamfara State. Hence suggested the need for principals to keep encouraging teachers under their leadership to keep abreast of new knowledge and skills through collaboration, mentoring, coaching etc.

Statement of the Problem

Zamfara State is burdened by shortage of qualified science and mathematics teachers (Zamfara State Secondary Education Assessment Committee [ZSSEAC], 2014). As a result of this situation, some arts and social science teachers are now required to teach science-related subjects. More so, according to ZSSEAC (2014), the majority of these teachers (64.79%) in the state are NCE holders. Many of whom lacks content and pedagogical knowledge (Isma'il & Lukman, 2022; Sodangi *et al.*, 2022). Perhaps this is why, as evidenced by their external examination results, secondary school students in the state have been persistently performed poorly in science and mathematics subjects. This signposted the need for intervention to improve teachers' effectiveness in teaching science and mathematics in the state. One of the frequently suggested ways to provide intervention is provision of professional development for the teachers. However, Sodangi *et al.*, (2022) revealed that, science and mathematics teachers in Zamfara State have low level of awareness on the forms of professional development programmes, and have not been participating in any.

Consequently, being the manager and administrator, school principals' role in the provision of professional development for teachers is called into question, as they are expected to create an enabling structural climate for proper and consistent professional development at their school levels. Conversely, research findings have shown that many principals fall short of their responsibilities. For instance, Oguejiofor *et al.*, (2022) revealed that, majority of schools are underperforming as a result of their principals' incompetence. This could be partly because, in Nigeria, the position of principal-ship is chosen based on teaching experience rather than leadership qualities. This is also coupled with the fact that, there is no provision for special or formal leadership training where principals are taught their responsibilities (Umar *et al.*, 2021).

Again, political interference has trumped the appointment of principals, which has a significant impact on their overall performance and administrative competence. Therefore, these factors cast doubt on the principal's administrative ability to influence teachers' professional development for teaching effectiveness and improved students' performance. This prompts the need to examine the perspectives of principal on their roles in influencing participation of science and mathematics teachers in professional development in Zamfara State. Specifically, the study seeks to answer the following research questions:

- i. What are the principals' roles in influencing professional development for science and mathematics teachers in Zamfara State?
- ii. What types of school-based professional development activities does principals organize for science and mathematics teachers in Zamfara State?
- iii. What are the challenges faced by principals in organizing professional development for science and mathematics teachers at school level in Zamfara State?

METHODS

Research Design

A qualitative research design was adopted for this study. This is because the role of school principal is a social phenomenon involving complex interactions among the factors associated with it. In this regard, it allows the researchers to gain a thorough understanding of participants' perspectives on science and mathematics teachers' professional development through their own words.

Population

The population of the study comprised all the principals of senior secondary schools in the four educational zones, namely; Gusau, Talata Mafara, Anka and Kauran Namoda of Zamfara State.

Sample and Sampling Techniques

Twenty (20) secondary school principals from the four educational zones in Zamfara State were sampled for the study. The small sample size is permitted under the principles of qualitative research because the core issue is dependability, trustworthiness, conformability, and adaptability of the information rather than representativeness (Creswell, 2003). The 20 school principals were purposively sampled based on the size of their schools in terms of having larger staff strength and student population. Six (6) principals were selected from Gusau Education Zone, 5 from Talata-Mafara Zone, 5 from Kauran Namoda Zone and 4 from Anka Zone. The distribution of interviewees from each zone was determined by taking into account the number of secondary schools in each of the zones.

Instrument for Data Collection

Data was collected through face-to-face interviews (Creswell, 2003). A structured interview was developed by the researchers through the review of related literature, the expert opinions, and also a pilot study. First, a draft interview guide with a number of questions was prepared by consulting the related literature and research questions. To ascertain its validity and reliability, the interview guide was presented to three experts in science education and measurement and evaluation for their opinion. After incorporating expert feedback, a pilot study was conducted with 3 secondary school principals from a neighboring state to test the sequence, content, and wording of open-ended questions included in the guide, as well as the approximate length of interview time. After the interview guide was revised based on the pilot study, seven (7) questions were set in the instrument and used for collection of data. The interview questions focused on key topics related to the study's purpose. The length of the interviews ranged from 30 to 45 minutes.

Data Analysis

Responses were transcribed, coded and categorized based on the research questions of this study to generate data for result presentation through content analysis. When transferring direct citations, each participant is given a code (P1, P2, P3...P20). Following the reduction of the data into major analytical categories, three main categories related to the research questions raised for the study emerged; principals' roles, types of school-based professional development activities and the challenges they face in organizing them for science and mathematics teachers at school level in Zamfara State.

RESULTS

The participants' average age was 41, with a range of 15 to 25 years of teaching experience. Furthermore, 3 of the 20 participants were female, while the remaining 17 were male. All the participants hold degree qualification in different fields of

education. Data collected through structured interviews with the twenty (20) principals from the four educational zones; Gusau, Talata Mafara, Anka and Kauran Namoda, were transcribed and hereby presented in line with the research questions that guided the study.

The Perceived Principals' Roles in Influencing Professional Development

A question was asked to establish the perception of principals' roles in influencing professional development for science and mathematics teachers in Zamfara State. In responding to this question, the principals seemed to lack a clear understanding of their roles in terms of provision of professional development for their science and mathematics teachers.

I believe it is the responsibility of the state government to provide funding for professional development for teachers...I don't have a clear understanding of the roles and responsibilities of principals in promoting professional development for science and mathematics teachers [P 5].

I have many other duties to attend to, and professional development for teachers is not always a priority to me...honestly, this aspect is the least in my mind, but now I think I will give it a thought [P 8].

I try to encourage my teachers to attend professional development workshops, but I don't have much influence beyond that [P 4].

...I don't have the necessary resources or support to promote professional development for science and mathematics teachers in my school... [P 9].

I think the government needs to do more to support principals in promoting professional development for teachers. Government has to be up to her responsibilities... [P 11].

I am not sure how to go about promoting professional development for science and mathematics teachers, so I leave it up to the individual teachers to seek out professional development opportunities [P 16].

...therefore, as far as I am concerned, the responsibility of retraining of science and other teachers in this school is a sole responsibility of their employer (government). I am sure you know I am also an employee too... [P 17].

Honestly, I have not received any training on how to organize or promote professional development for science and mathematics teachers in my school. So, I never thought of one for my teachers... [P 18].

I have been making efforts...I feel that my efforts to promote professional development for science and mathematics teachers are often hindered by bureaucratic obstacles [P 20].

School-Based Professional Development Organize by Principals

In this area of importance, the researchers raised question to find out the types of school-based professional development activities that principals organize for science and mathematics teachers in Zamfara State. The principals' responses were as thus;

...I don't have the resources or funding to organize any professional development activities for teachers... [P 1].

We sometimes organize in-house training sessions for teachers, but these are usually ad hoc and often times I do question the effectiveness of these sessions... [P 4].

I have tried to organize external workshops and training sessions for my teachers, but this requires a lot of time and effort... [P 7].

We don't have enough teachers to cover classes while others attend professional development activities. We encourage teachers to attend external training sessions, but we don't organize any ourselves [P 11].

...I sometimes organize peer-to-peer training sessions, where teachers can share their knowledge and expertise with each other... [P 15].

I am not sure what types of professional development activities would be most effective for science and mathematics teachers... [P 16].

I have not received any training or guidance on how to effectively organize professional development activities for my teachers [P 17].

...so, we sometimes bring in external experts to give talks or workshops, but this is not a regular occurrence. [P 19].

...You need to understand that, as a principal we have limited resources and funding, so we are not able to organize many professional development activities for our teachers [P 20].

Principals' Challenges in Organizing Professional Development

The participants were asked "What are the challenges faced by principals in organizing professional development for science and mathematics teachers at school level in Zamfara State?" The participants' responses indicated that there are several challenges confronting them in organizing school-based professional development for science and mathematics teachers in the state.

...We don't have enough funding or resources to organize effective professional development activities for our teachers... [P 2].

It can be difficult to find suitable training programmes and workshops for science and mathematics teachers in our area...there is a lack of awareness among teachers and principals in Zamfara State about the importance of professional development for science and mathematics teachers [P 5].

...Many of our teachers are not interested in attending professional development activities, besides it is difficult to find time in the school schedule to allow teachers to attend professional development activities [P 7].

...We don't have enough teachers to cover classes while others attend professional development activities [P 11].

...The bureaucratic process of organizing professional development activities can be time-consuming and frustrating [P 15].

The limited number of qualified science and mathematics teachers and not paying them good salary hinders my teacher from participating in professional development. This is a challenge to me... [P 19].

We are often not able to provide adequate incentives or rewards for teachers who attend professional development activities. And more so, the lack of support from the state government is a major challenge [P 20].

DISCUSSION

The first research question explored the roles of principals in influencing professional development for science and mathematics teachers in Zamfara State. The interview responses indicated that the principals are deficient in clear understanding of their roles and responsibilities in promoting professional development for science and mathematics teachers. The findings revealed that, only few principals see organizing professional development activities as a necessary part of their job. Research by Leithwood and Riehl (2005) underscored the importance of effective leadership and crucial role play by principals in promoting and organizing professional development for teachers in effort to improve student learning outcomes. Similarly, Koonce *et al.*, (2019) and Greitāns *et al.*, (2021) emphasized the need for good educational leadership by school administrators to ensure that professional development is prioritized and effectively implemented. In line with this, a study conducted by Yost and Sentz (2018) revealed that, principals play a critical role in promoting professional development activities for teachers. This means that principals' lack of understanding of their in planning and executing professional development raised a serious concern because this singular act can thwart efforts to improve the quality of science and mathematics education in the State.

The second research question aimed to explore the types of school-based professional development activities that principals organize for science and mathematics teachers in Zamfara State. The result showed that, the majority of the principals interviewed do not organize specific professional development activities for their science and mathematics teachers. This finding corroborated with Okafor *et al.*, (2021) assertion that, professional development for teachers in

Nigeria is often neglected due to the lack of good educational leadership by school administrators, More so, some principals e.g. [p 16] indicated that, they were not sure what types of professional development activities would be most effective for science and mathematics teachers. The study also revealed that, the few principals concern with professional development programmes do so mostly through external sources such as workshops and seminars, rather than through internal school-based programmes. This practice is inconsistent with the proposition of Sodangi *et al.*, (2022) that suggested greater emphasis should be placed on teacher's professional development within a school developmental/improvement strategy.

The finding further revealed that, while few principals may be organizing professional development activities, the nature of the activities may not be sufficient to support sustained growth and improvement in their teachers' teaching practices. For instance, a response by one principal [P 4] indicated that in-house training sessions were sometimes organized for teachers, but they were ad hoc and not very effective. This finding is in line with the study of Guskey and Yoon (2009) and Darling-Hammond and McLaughlin (1995) that revealed that, one-time, short-duration professional development programmes are often insufficient for bringing about sustained changes in teacher practice.

The third research question sought to identify challenges faced by principals in organizing professional development for science and mathematics teachers at the school level in Zamfara State. The study revealed that, principals faced several challenges, the major ones being the lack of resources and funding. This finding is consistent with findings of Darling-Hammond and McLaughlin (1995) and Garet *et al.*, (2001) that have identified inadequate funding as a major barrier in providing quality professional development for teachers. Lack of time was also revealed to be a challenge, for instance principal [P 7] complained that no time to schedule professional development activities. Similarly principal [P 15] expressed that, organizing professional development is time consuming due to bureaucracy involve. This finding is consistent with Acuña and Ancho (2022) that has identified administrative challenges as a significant barrier to effective professional development. This supported the assertion of Fullan, (1995) that, there is need for principals to have a clear understanding of the time and resource requirements for organizing effective professional development programmes.

The study revealed that, other challenges mentioned by the principals include competing demands, inadequate support from higher authorities and difficulty in finding suitable training programmes for science and mathematics teachers in their area of specializations. These challenges often hindered their

ability to plan, organize, and implement effective professional development activities for their teachers. This finding is consistent with Desimone (2009) that has identified a lack of access to relevant needs for professional development opportunities as a significant barrier to teachers' professional development. The study also revealed that some principals e.g. [P17] had not received any training or guidance on how to effectively organize professional development activities for their teachers. This finding highlights the importance of providing principals with the necessary training and support in designing and implementing effective in-school professional development activities.

CONCLUSION

This study provides insights into the role of principals in influencing participation of science and mathematics teachers in professional development in Zamfara State. The findings of this study indicated that while some principals are actively involved in organizing professional development activities for their teachers, a significant number of principals do not play their role as expected in that regard. The study also revealed that the types of professional development activities organized by principals are limited in scope and not always effective in improving the teaching practices of science and mathematics teachers. Furthermore, the challenges faced by principals in organizing professional development activities for their teachers are numerous and range from inadequate funding to lack of teacher motivation.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations are put forward;

1. Principals should be more proactive in playing their role in influencing the professional development of their teachers.
2. School principals should collaborate with other stakeholders, such as education experts and professional associations, to develop and implement effective professional development programmes for science and mathematics teachers.
3. There is a need for the Zamfara State government to provide more funding and support for professional development activities in schools.
4. The Ministry of Education should organize training and capacity-building programmes for school principals on effective strategies for promoting and organizing professional development at school level especially for science and mathematics teachers.
5. The Ministry of Education should develop policies and guidelines that clearly define the roles and responsibilities of school principals in promoting professional development for science and mathematics teachers.

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CONFLICT OF INTEREST

The authors declare that they have no competing interests

REFERENCES

- Achimugu, L., & Obaka, H. P. (2011). Influence of principals' leadership styles on senior secondary school students' achievement in chemistry. *Science Education Internationa*, 30(2), 92–96. <https://doi.org/https://doi.org/10.33828/sei.v30.i2.2>
- Acuña, L. J., & Ancho, I. V. (2022). Leadership Innovations during COVID-19 Pandemic: Practices of Filipino Principals in Teacher Professional Development. *E-Jurnal Penyelidikan Dan Inovasi*, 9(2), 135-155. [https://ejpi.kuis.edu.my/index.php/ejpi`](https://ejpi.kuis.edu.my/index.php/ejpi)
- Arikewuyo, M. (2007). Teachers perception of principals leadership capacities in Nigeria. *Academic Leadership: The Online Journal*, 5(3).
- Bada, H. A., Faekah, T., Ariffin, T., & Nordin, H. B. (2020). The effectiveness of teachers in Nigerian secondary schools: The role of instructional leadership of Principals. *International Journal of Leadership in Education*, 00(00), 1–28. <https://doi.org/10.1080/13603124.2020.1811899>
- Darling-Hammond, L., & McLaughlin, M. W. (1995). Policies that support professional development in an era of reform. *Phi Delta Kappan*, 76(8), 597-604
- Desimone, L. (2009). Improving impact studies of teachers' professional development: Toward better conceptualizations and measures. *Educational researcher*, 38(3), 181-199.
- Eboka, O. C., & Mbanefo, A. C. (2022). Professional development of science teachers: implications for quality assurance in science education. *A Conference Paper*.
- Egboka, P. N. (2018). Principals' Application of Management Support Practices for Enhancing Teachers Job Performance in Secondary Schools in Enugu State, Nigeria. *International Journal of Research*, 5(17), 582-590.
- Federal Republic of Nigeria. (2013). *National policy on education* (6th ed.). NERDC Press.
- Fullan, M. (1995). The limits and the potential of professional development. *Phi Delta Kappan*, 76(8), 594-596.
- Garet, M. S., Porter, A. C., Desimone, L., Birman, B. F., & Yoon, K. S. (2001). What makes professional development effective? Results from a national sample of teachers. *American educational research journal*, 38(4), 915-945.
- Greitāns, K., Eriņa, D., & Namsone, D. (2021). Linking teacher professional development needs with appropriate solutions: insights from an initiative in Latvia. *Society. Integration. Education Proceedings of the International Scientific Conference*, IV, 113–123. <https://doi.org/10.17770/sie2021vol4.6388>
- Guskey, T. R., & Yoon, K. S. (2009). What works in professional development? *Phi Delta Kappan*, 90(7), 495-500.
- Isma'il, A., & Cyril, M. (2022). The link between stem education and technology transfer in fostering creativity and innovation. *Science Teachers Association of Nigeria, 62nd Annual Conference Proceedings*, 170-178.
- Isma'il, A., & Lukman, O. M. (2022). Availability and Utilization of Instructional Materials in Teaching and Learning of Biology in Senior Secondary Schools. *Aquademia*, 6(2), ep22013. <https://doi.org/10.30935/aquademia/12614>
- Koonce, M., Pijanowski, J. C., Bengston, E., & Lasater, K. (2019). Principal engagement in professional development process. *NASSP Bulletin*, 103(3), 229-252.
- Kotirde, I. Y., & Yunos, J. Bin. (2014). Teachers' role in improving teaching and learning in Nigerian secondary schools' education. *International Journal of Research and Reviews in Education*, 1, 22–27.
- Leithwood, K., & Riehl, C. (2005). What we know about successful school leadership. Philadelphia, PA: Laboratory for Student Success.
- Oguejiofor, N. C., Igbokwe, I. C., & Amaeze, F. E. (2022). Management of principals' social skills as correlates of effective school organization in public secondary schools in Enugu State, Nigeria. *Webology*, 19(3), 75-86.
- Okafor, I. A., Mbagwu, S. I., Eze, C. E., Oluwatayo, J. C., Anachuna, O. N., & Obialor, C. O. (2021). Train-the-trainers biology workshop as an effective science advocacy tool: an impact assessment and emerging issues for science education. *Journal of STEM Outreach*, 4(1), 1–10. <https://doi.org/https://doi.org/10.15695/jstem/v4i1.0>
- Olujuwon, T., & Omiyale, P. (2021). The impact of in-service training on teachers' professional development in Lagos State public secondary schools. *Educational Journal of Multidisciplinary Studies*, 18(1), 326-334.
- Paul, V. B. (2000). The school principal's role in teacher professional development, *Journal of In-Service Education*, 26(2), 385-401.

- <https://doi.org/10.1080/1367458000200114>
- Sodangi, U., Isma'il, A., & Abdulrahman, A. (2022). Perception of secondary school science and mathematics teachers on Professional development participation in Zamfara State, Nigeria. *Integrity Journal of Education and Training*, 6(2), 37–45. <https://doi.org/https://doi.org/10.31248/IJET2022.138>
 - Umar, O. S., Kenayathulla, H. B., & Hoque, K. E. (2021). Principal leadership practices and school effectiveness in Niger State, Nigeria. *South African Journal of Education*, 41(3), 1–12. <https://doi.org/https://doi.org/10.15700/saje.v41n3a1859>
 - Westberry, L., & Horner, T. (2022). Research Article Best Practices in Principal Professional Development. *AASA Journal of Scholarship and Practice*, 19(1), 29-47.
 - Yost, D. S., & Sentz, L. (2018). Principal Leadership and Teacher Professional Development: An Exploratory Study. *Journal of Education and Practice*, 9(9), 25-33
 - Zamfara State Secondary Education Assessment Committee [ZSSEAC]. (2014). *Main Report, Volume I*.