(RESEARCH ARTICLE)

Examining the influence of teacher distribution, infrastructure development, and government funding on student educational attainment in rural Ghana

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Abstract

Introduction/Background: Education is a basic cause of socio-economic growth, yet rural places in Ghana, especially the Volta Region, face significant obstacles that limit student educational achievement. Unequal teacher spread, poor facilities, and insufficient government funds have been named as major barriers to better educational results. Despite numerous studies on factors affecting student achievement, limited research has directly studied the combined effects of these three variables in the Volta Region. This study tries to bridge this gap by examining the impact of teacher distribution, infrastructure development, and government support on student educational success levels in rural parts of the Volta Region, Ghana**.**

Materials and Methods: This quantitative study employed survey and cross-sectional research methods to collect data from primary and secondary school teachers in rural parts of the Volta Region. Due to the lack of a precise count of rural teachers in the area, Cochran's method for an unknown population was used to estimate a sample size of 385 responders. Data was taken using an organised, self-developed questionnaire, distributed through a simple random sampling method over three months. In total, 312 full answers (81% response rate) were reviewed. The study applied Structural Equation Modeling (SEM) to measure the links among teacher distribution, infrastructure development, government funding, and student educational success levels.

Results: The results showed that teacher distribution, building development, and government funds each have a major effect on student educational success levels in rural areas of the Volta Region. A well-balanced teacher spread was linked with better student success, stressing the importance of fairly giving skilled educators. Infrastructure growth, including well-equipped classes, libraries, and cleaning facilities, positively impacted learning results. Similarly, greater government spending for teacher training, teaching tools, and school facilities led to improved educational attainment. The SEM analysis showed that all three independent factors greatly added to differences in student achievement.

Discussion: The results agree with the Education Production Function (EPF) Theory, which posits that educational outcomes are based on important factors such as teacher quality, facilities, and financial resources. The study's results support the need for focused policy measures to improve teacher placement in rural schools, boost infrastructure development, and increase financial spending in education. The consequences of these results stretch beyond the Volta Region, giving useful insights for education officials in other emerging areas facing similar problems.

Conclusion: This study conveys empirical evidence that teacher distribution, infrastructure growth, and government support are key factors of student educational success in rural Ghana. To bridge the educational gap between urban and rural areas, lawmakers must adopt teacher benefits, invest in school facilities, and give suitable financial resources to rural education. Future research should explore additional factors affecting student success and consider continuous studies to track educational growth over time.

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1. Introduction

Education is generally known as a key cause of economic growth, social development, and individual freedom (Morris, Muchira and Dobrowolski, 2022). It improves brain skills, develops critical thought, and gives people with the information and abilities needed to engage successfully in society (Olurotimi, Olusola and Ekere, 2015). Quality education has been linked to better salary levels, poverty decrease, and total social growth. Governments and foreign groups continue to stress investment in education as a basic tool for achieving sustainable development, especially in low-income and emerging countries (Wildschut and Megbowon, 2020). In Ghana, education acts as a route for upward social mobility, allowing people to break the circle of poverty and add effectively to national growth.

Sadly, rural areas in Ghana have not fully accepted education due to several socio-economic and social obstacles (Anlimachie, 2015). Many rural towns battle with poor school buildings, a lack of trained teachers, and limited access to educational tools (Abdul-rahaman *et al.*, 2018). The economic problems faced by rural families often force children to favour economic activities over learning, leading to high dropout rates (Elias and Mwila, 2022). Additionally, long journey lengths to schools, bad facilities, and insufficient government funds further widen the gap between rural and urban educational success (Anlimachie, 2015). These inequalities have long-term effects, as students from rural areas are less likely to move to higher levels of education, thereby reducing their chances for better jobs and improved living conditions (John and Aliyu, 2022).

The Volta Region, like other rural places in Ghana, faces major difficulties in providing decent schooling for its people. Many schools in the area run with inadequate equipment, including a lack of proper classes, insufficient learning tools, and bad cleaning facilities (Anlimachie, 2015). The lack of trained and experienced teachers in rural schools exacerbates the situation, as urban areas attract most qualified educators due to better living conditions and job possibilities. Additionally, the region's economic problems and cultural factors add to poor school attendance and high dropout rates. Addressing these problems is important to better the educational results of children in the area and supporting regional growth.

Teacher distribution remains one of the key factors of educational success, yet rural places in the Volta Region suffer from an uneven sharing of teachers. Most skilled teachers prefer urban jobs due to better rewards, access to social amenities, and professional growth possibilities (Muthengi and Romata, 2022). Consequently, country schools are left with fewer and less-qualified teachers, harming the level of teaching and student success. The lack of trained teachers for science, mathematics, and technical topics further limits students' exposure to critical skills necessary for national growth. To close this gap, policies aimed at incentivizing rural teaching jobs and improving teacher welfare must be adopted.

Similarly, bad educational infrastructure in the Volta Region continues to hinder effective learning. Many students study in packed and outdated classes, while others learn under trees due to a lack of fixed structures. The lack of necessary services such as libraries, labs, and dependable power affects students' ability to participate in valuable learning experiences (Fagbohunka, 2017). Additionally, poor school transportation systems force many children to walk long distances, lowering their attendance and academic success (John and Aliyu, 2022). Investments in school facilities are crucial to providing a suitable learning setting that supports student success.

Government funding plays a vital role in solving these educational issues, but rural schools in the Volta Region often receive poor financial help. Limited financial amounts to distant schools affect teacher recruiting, building development, and the provision of learning tools (John and Aliyu, 2022). Moreover, grant programs and financial help for students from low-income homes remain insufficient, stopping many from finishing their education (Abdul-rahaman *et al.*, 2018). Strengthening government dedication to rural education through greater funds, focused policy measures, and community involvement will be important in ensuring that every child in the Volta Region has access to quality education and the chance to achieve their full potential.

A number of studies have been performed e.g., Oluwatoyi, Isaiah and Awusah, 2022; Fagbohunka, 2017; Adebayo and Jolaosho, 2022; Muthengi and Romata, 2022; 2022 to improve educational success levels internationally, with a particular focus on factors such as teaching quality, school facilities, and government funds. However, to the best of our knowledge, no study has been conducted in the Volta Region to measure the impact of teacher distribution, facilities, and government spending on student educational attainment levels. Given the unique socio-economic and physical

features of the area, knowing the specific issues affecting students' educational results is important for building focused solutions.

Hence, this study is performed to fill this research gap by studying how teacher distribution, infrastructure, and government funds impact student educational success levels in the Volta Region. The results will provide factual proof to help lawmakers, educators, and partners in designing successful policies and programs that address the educational inequalities faced by students in rural Ghana. Through this study, we hope to add to the larger debate on better rural education and ensuring equal access to quality learning chances for all children.

1.1. Statement of Problem

Education remains a key cause of socio-economic development, yet rural places in Ghana, including the Volta Region, continue to face significant obstacles to getting high educational results (Bohnenkämper *et al.,* 2022). Poor teacher spread, poor school facilities, and insufficient government funds have caused a gap between country and urban education, limiting students' academic success (Fagbohunka, 2017). Many rural schools battle with packed classes, a lack of trained teachers, and poor learning tools, which negatively impact student performance and increase failure rates (John and Aliyu, 2022). While urban schools benefit from better educational resources and government help, country schools are left under-resourced, making it difficult for students to achieve higher levels of education (Okoroma, Edo and Okonko, 2022).

Despite different national education policies aimed at better student performance, the unique issues facing rural schools in the Volta Region remain largely ignored (Morgan*et al.,* 2022). Previous studies have studied factors affecting education in Ghana, but no research has specifically examined how teacher distribution, facilities, and government funds influence student educational success in this area. Without actual data on these key factors, officials may struggle to adopt focused measures to close the educational gap between rural and urban places. Therefore, this study aims to fill this research gap by studying the amount to which these factors impact student success in the Volta Region, offering evidence-based suggestions to improve rural education and promote fair learning opportunities.

Aim and Objectives of the Study

- The main aim of this study is to examine the influence of teacher distribution, infrastructure, and government funding on student educational attainment levels in the Volta Region of Ghana. Specifically, the study aims to:
- Assess the influence of teacher distribution on student educational attainment levels in rural schools in the Volta Region.
- Explore the effect of school infrastructure on student educational attainment levels in rural areas of the Volta Region.
- Investigate the influence of government funding on student educational attainment levels in the Volta Region.

2. Review of Extant Literature

This section review literature on student educational attainment levels, teacher distribution, infrastructure development and government funding, empirical review and theoretical framework.

2.1. Concept of Student Educational Attainment Level

Student educational attainment level is generally described as the best level of education a person has finished, showing their official academic results (Deng *et al.*, 2014). It covered not only the finishing of degrees or certifications but also the cumulative learning process that includes knowledge of academic skills such as reading, math, and problem-solving (Oluwatoyi, Isaiah and Awusah, 2022). Klein-Collins (2012) stressed that educational completion acts as a key sign of academic success and economic movement, shaping an individual's job chances and social standing. Additionally, it represents students' ability to learn and apply information, showing their cognitive and behavioral skills gained through traditional education (Adelman, Iet al., 2014). Farrington *et al.,* (2012), noted that educational attainment is also a vital measure of school efficiency, as it shows the extent to which students have gained the necessary skills for ongoing learning.

Moreover, student educational attainment is affected by various factors, including teacher placement, facilities, and government support, all of which add to the level of education received (Barbera *et al.,* 2020). Studies have shown that fair access to well-trained teachers and suitable learning spaces greatly improves student success and attainment rates (Chirimbana, Kashweka and Amunime, 2022; LaFave, 2020; Gaytos, Lavilla and Cablao, 2020). Furthermore, educational attainment is not simply about academic achievements but also includes the development of critical thinking, speech,

and social skills necessary for useful participation in society (LaFave, 2020). As educational policies change, experts stress the importance of solving gaps in access to quality education to ensure that all students, regardless of their socio-economic background, can achieve high levels of educational achievement (Gaytos, Lavilla and Cablao, 2020.). Overall, student educational attainment level indicates a complex result of the educational process, showing both official qualifications and the wider skills gained through organised learning experiences.

2.2. Concept of Teacher Distribution

Teacher distribution refers to the sharing of educators across different schools and regions, trying to ensure that all students, regardless of location or socio-economic background, have access to quality teaching (Bello, 2021). It includes the planned placement of teachers based on factors such as subject knowledge, training, experience, and school needs (Qin and Bowen, 2019). However, differences in teacher distribution remain a global challenge, as urban and wealthy schools tend to attract more qualified and experienced educators, while rural and poor schools deal with gaps and high turnover rates (Muthengi and Romata, 2022). This uneven distribution negatively impacts student learning results, as less-experienced teachers are often given to poor schools, further increasing educational gaps (Mason-Williams, 2015).

Addressing the problem of teacher distribution requires policy measures that support fair placement and retention of educators. Governments and educational institutions have adopted strategies such as cash rewards, living support, and professional development programs to draw and keep teachers in poor areas (Larsen *et al.,* 2020). However, Loeb and Reininger (2004) argued that beyond financial rewards, better working conditions, offering mentoring, and supporting job growth chances are important for long-term teacher retention in impoverished schools (See *et al.,* 2020). The success of teacher distribution policies greatly affects student performance and total educational progress, making it a critical factor in promoting educational equality and reducing the achievement gap (Darling-Hammond *et al.*, 2019).

2.3. Concept of Infrastructure Development

Infrastructure development refers to the process of building, growing, and improving important physical and organizational structures necessary for society and economic growth (Adebayo and Jolaosho, 2022). These structures include transportation networks, energy systems, water supply, communication facilities, and public organisations such as schools and hospitals (Fagbohunka, 2017). According to Okoroma, Edo and Okonko (2022), infrastructure assets are described as physical assets, structures, or facilities, systems, and networks that provide or support essential public services. Similarly, Nehemiah (2022), described infrastructure as the basic facilities and systems serving a country, city, or area, such as transportation, power plants, and schools. Indeed, Karpenko *et al.* (2021), noted that infrastructure development is crucial for improving economic security and long-term growth by offering necessary services that support both urban and rural development.

Furthermore, infrastructure development plays a significant part in supporting economic success by improving access to markets, enhancing output, and allowing better living standards (Kaiser and Barstow, 2022). It includes strategic planning, funding, and delivery of projects aimed at improving vital services for both the public and private sectors (Odhiambo, 2020). The Organization for Economic Co-operation and Development (OECD, 2019), described infrastructure development as the creation and improvement of basic facilities and systems necessary for economic activities and social well-being. Additionally, Adshead *et al.* (2019), emphasized that sustainable infrastructure development should value resilience, environmental protection, and inclusion to ensure long-term benefits. Collectively, these academic meanings stress the vital role of infrastructure development in driving economic, social, and environmental progress.

2.4. Concept of Government Funding

Government funding in the setting of education refers to the financial resources given by federal, state, or local governments to support educational schools and projects (Azi and Usman, 2022). This funding includes various forms, including direct fiscal transfers, handouts, rebates, and financial aid programs, all aimed at ensuring the accessibility, quality, and sustainability of educational services (Azi and Usman, 2022). Abdul-rahaman *et al.* (2018), described government funding in education as the financial resources given by public bodies to support the running and growth of educational institutions and services. Similarly, Nyakoe (2020), viewed it as the monetary payments from government bodies directed towards the running and improvement of schools and educational programs. These categories show the important role of government funds in keeping and improving educational facilities and possibilities.

In the educational sector, government support acts as a crucial tool to promote fair access to learning opportunities, reduce gaps, and improve general educational results. For instance, Morris, Muchira and Dobrowolski (2022), noted

that public funding methods are important for paying ongoing learning and ensuring that education systems can respond to changing social needs. Furthermore, government support impacts academic success by giving necessary tools such as skilled teachers, learning materials, and building changes (Bara *et al.*, 2022). Thus, government support is vital to the growth and longevity of effective educational systems.

2.5. Empirical Review

Empirical studies highlight that teacher demographics and distribution significantly impact student academic performance. Olurotimi, Olusola, and Ekere (2015), found that teacher effectiveness varies by gender and location, with an uneven distribution of teachers between urban and rural areas. Similarly, Muthengi and Romata (2022), revealed that teacher transfers and shortages negatively affect student performance, particularly in rural schools. These findings suggest that equitable teacher allocation is crucial for improving learning outcomes, as disparities in teacher distribution contribute to differences in academic achievement.

School infrastructure and instructional facilities are also critical determinants of student performance. Elias and Mwila (2022), and John and Aliyu (2022), found that inadequate school infrastructure, including libraries, laboratories, and classrooms, negatively affects learning, particularly in rural areas. Supporting this, Adebayo and Jolaosho (2022), Nehemiah (2022), and Fagbohunka (2017), emphasized that well-equipped schools significantly enhance academic performance. Similarly, Okoroma, Edo and Okonko (2022), demonstrated that instructional facilities play a vital role in student learning, particularly in non-formal and adult education programs. These studies collectively indicate that investments in school infrastructure and learning resources are essential for fostering an effective educational environment.

Government funding plays a crucial role in addressing disparities in education by improving infrastructure, instructional resources, and teacher distribution. Abdul-Rahaman et al. (2018) and Nyakoe (2020), found that government funding significantly enhances student performance, particularly through free education policies. Azi and Usman (2022), further demonstrated that government funding positively influences teaching outcomes in public secondary schools in Nigeria, while Bara et al. (2022), found similar effects in universities. These findings highlight the necessity of sustained government investment in education to bridge infrastructural gaps and ensure equitable resource distribution. Addressing these issues through strategic policy interventions can lead to improved student academic performance across various educational levels.

- *H1a:* Teacher distribution has significant effect on student educational attainment levels in rural area Volta Region of Ghana.
- *H1b:* Infrastructure development has significant effect on student educational attainment in rural area levels in Volta Region of Ghana.
- *H1c:* Government funding has significant effect on student educational attainment levels in rural area Volta Region of Ghana.

2.6. Education Production Function (EPF) Theory

The Education Production Function (EPF) Theory is an economic framework that shows how educational factors affect how well students learn (Becker, 1988). The EPF theory is based on the idea of production functions in economics. It says that student success (output) is affected by things like the quality and distribution of teachers, school infrastructure, government funding, and other resources (Hanushek, 1979). The theory is that education works like a production system, with different inputs that help people learn. Differences in these inputs can cause differences in how much education people have. A lot of people in the field of education economics use the EPF framework to figure out how efficiently and effectively school resources are used and to help policymakers decide how much to spend in education (Hanchane and Mostafa, 2012).

The EPF theory is especially useful for rural education because it helps explain how differences in the number of teachers, school facilities, and government funds affect how well students do in school. For example, bad infrastructure like bad school buildings and not having enough learning materials can make it harder for students to learn. Also, different regions may have different levels of student success due to an uneven distribution of teachers. In the same way, government funding is a big part of making sure that learning tools like qualified teachers, teaching materials, and student support services are available. Researchers and policymakers can use the EPF theory to figure out which inputs have the biggest effect on student success. This helps them come up with targeted ways to improve education, especially in places like rural Ghana where students are not well off.

3. Methodology of Data Collection

This study explores teacher distribution, infrastructure development, and government funding affect students' educational attainment in rural areas of Ghana's Volta Region. It is quantitative and uses both survey and cross-sectional research methods. The survey method involves carefully collecting data from a targeted group using structured tools such as questionnaires and interviews (Ojeleye, Abu-Abdissamad, *et al.*, 2022). This method is widely known for gathering information on respondents' opinions, perceptions, behaviors, and characteristics in an organized and standardized way (Sekaran and Bougie, 2016). The survey method is particularly useful for this study, as it allows for the collection of first-hand answers from primary and secondary school teachers who directly experience and observe the educational challenges in rural areas. Additionally, the study adopts a cross-sectional research design, which includes collecting data from the target population at a single point in time (Ojeleye, Kareem, *et al.*, 2022). This method is useful for finding patterns, relationships, and differences among variables without manipulating them, making it particularly effective for descriptive and correlational research (Creswell and Creswell, 2018). By analyzing data from teachers at a particular time, this study gives a snapshot of the current state of teacher distribution, infrastructure conditions, government funding, and their impact on student educational attainment. The study domain comprises primary and secondary school teachers in rural parts of the Volta Region, Ghana. However, due to the lack of an exact record of the total number of teachers in rural schools across the region, the study applied Cochran's sample size formula for an infinite/unknown population, as suggested by Ojeleye, Mustapha *et al.* (2022). Using this formula, a sample size of 385 teachers was found to be appropriate for the study. To gather data, 385 structured, self-developed questionnaires were given to teachers working in rural schools across the Volta Region. The distribution was performed using a simple random sampling technique, ensuring that every eligible teacher had an equal chance of participating in the study. The data collection method spanned three months, allowing ample time for responses. Out of the 385 questionnaires distributed, 312 were successfully completed and returned, indicating a response rate of 81%. These completed responses were later used for data analysis, providing valuable insights into the study objectives.

Self-developed instruments were utilised for the study using a 5-point Likert scale 1= strongly disagree and 5= strongly agree. Teacher distribution was measured using 5-item Teacher distribution scale with reported Cronbach's alpha of 0.722. Sample of item is "Teachers in my school are fairly distributed across different grade levels". Infrastructure development was measured using 5-item Infrastructure development Scale with reported Cronbach's alpha of 0.751 showing its instrument reliability. Sample of item is "My school has enough classrooms for all student". Government funding was measure using 5-item Government funding with reported Cronbach's alpha of 0.845. Sample of item is "My school receives enough government funding to support learning activities". student educational attainment level was measured using 4-item with reported Cronbach's alpha of 0.834. Sample of item is "I feel confident about my students completing their education successfully".

3.1. Data Analysis and Presentation

Data were analysed using Statistical Software for Social Sciences SPSS for preliminary analyses such as detection of outliers, multicollinearity, normality and common method bias tests were performed on the data collected. Structural Equation Model particularly, Smart-PLS was employed to test construct outer loading, reliability, validity, coefficient of determination R^2, and the hypothesised relationships using structural and measurement models.

3.2. Evaluation of Measurement Model

Measurement model was applied to measure first the outer loading. Hair *et al.* (2022), suggested keeping loadings of 0.7 and above. However, due to the chance of having loadings of less than 0.70 in social science research, they supported keeping loadings between 0.4 to 0.7 based on the effect of these loadings range on construct reliability and average variance extracted AVE. Contrarily, (Hulland, 1999; Ojeleye, Ojeleye *et al.,* 2022), advised the preservation of loads of ≥0.5. As such, this study removed outer loadings of <0.5 limits. Based on this suggestion loadings no loading was deleted due to loadings <0.5 See: Table 1. Furthermore, the constructs' reliability was tested using composite reliability and Cronbach's alpha. Hair *et al.* (2017), suggested a level of ≥0.7 to show that the concept reliability is promised and the tool of the study is consistent and suitable. Table 1 below shows that the values of combined reliability and Cronbach's alpha ratings are all greater than 0.70. Hence, the designs of the study are solid. In addition, convergent validity was tested using average variance extracted (AVE). Fornell and Larcker (1981), proposed that for a construct to have convergent validity, the number of AVE must not be <0.5. As shown in Table 1 below, the AVE values are all >0.5 showing that convergent validity is proven.

Meanwhile, the coefficient of determination R^2 depicted in Table 3 below is 0.424 (42.4%) Model. The model shows that 42.4% variation in student educational attainment level is explain by the independent variables i.e., TD, GF and ID while

the remaining 57.6% is attributed to other variables not included in the model. According to Cohen (1988), the R^2 explanatory power for the Model considered moderate.

Table 1 Outer loadings, Reliability and Convergent Validity

Constructs	Indicators	Outer loadings	Cronbach's alpha	Composite Reliability	AVE	Decision
Government Funding	GF1	0.723	0.845	0.894	0.513	Accepted
	GF2	0.801				
	GF3	0.745				
	GF4	0.719				
	GF5	0.592				
Infrastructural Development	ID1	0.813	0.751	0.812	0.652	Accepted
	ID2	0.823				
	ID3	0.859				
	ID4	0.672				
	ID5	0.729				
Student Educational Attainment Level	SEAT1	0.922	0.834	0.878	0.649	Accepted
	SEAT2	0.888				
	SEAT 3	0.752				
	SEAT4	0.817				
Teachers Distribution	TD1	0.717	0.722	0.779	0.537	Accepted
	TD2	0.729				
	TD3	0.608				
	TD4	0.711				
	TD5	0.541				

Additionally, discriminant validity was evaluated using the Heterotrait-Monotrait HTMT ratio of correlation. Since the constructs are conceptually different HTMT 0.85 threshold as recommended by Kline (2011), was employed as against HTMT 0.9 recommended by Henseler et al. (2015), for conceptually similar constructs. Table 2 below shows that the values are all less than the 0.85 threshold. Thus, discriminant validity is confirmed.

Table 2 Discriminant validity using HTMT correlations

Construct	Government Funding	Infrastructural Development	Student Educational Attainment Level	Teachers Distribution
Government Funding				
Infrastructural Development	0.572			
Student Educational Attainment Level	0.644	0.374		
Teachers Distribution	0.563	0.552	0.529	

3.3. Evaluation of Structural Model

The structural model was used to evaluate the hypothesized relationship

Table 3 Hypothesized Relationship

Hypotheses	Relationship	Beta	Standard Deviation	T Statistics	P Values	Decision
HL1a	Teacher distribution -> Student Educational Attainment Level	0.237	0.043	5.512	0.000	Supported
HL1b	Infrastructural Development -> Student Educational Attainment Level	0.118	0.024	4.917	0.000	Supported
HL2c	Government Funding -> Student Educational Attainment Level	0.317	0.032	9.906	0.000	Supported

Model: Q2 = 0.232

The results presented in Table 3: Hypothesized Relationship indicate that all three independent variables—teacher distribution, infrastructural development, and government funding—have a statistically significant effect on student educational attainment levels in rural areas of the Volta Region, Ghana. The standardized beta coefficient for teacher distribution (β = 0.237, p = 0.000, T = 5.512) suggests a moderately strong positive impact, implying that better distribution of teachers enhances student attainment levels. Similarly, infrastructural development (β = 0.118, p = 0.000, T = 4.917) is also positively related to student educational attainment, although with a slightly lower impact compared to teacher distribution, indicating that while infrastructure improvements contribute to learning outcomes, their effect may be dependent on other factors. The strongest predictor of student educational attainment is government funding (β = 0.317, p = 0.000, T = 9.906), showing that increased financial investment in education significantly enhances learning outcomes. The model's predictive accuracy is represented by Q^2 = 0.232, meaning that the combined influence of these factors explains approximately 23.2% of the variance in student educational attainment levels, highlighting the critical role of resource allocation in improving education in rural Ghana.

4. Discussion

Research findings suggested that teacher distribution had a substantial effect on student educational achievement levels in rural parts of the Volta Region, Ghana. The availability, qualification, and equal distribution of teachers play a key impact in molding students' academic achievement (Muthengi and Romata, 2022). In rural schools, where there is generally a shortage of trained teachers, pupils encounter inferior instructional quality, leading to weaker learning outcomes. Studies have indicated that when experienced and well-trained instructors are concentrated in metropolitan areas, rural kids are left with less-qualified or overloaded teachers, significantly harming their educational advancement (Acheampong & Osei, 2022). Additionally, teacher shortages in rural schools can lead to high class numbers, fewer individualized attention, and poorer student engagement, further decreasing educational attainment (Muthengi and Romata, 2022). Conversely, when teacher distribution is more balanced—ensuring that rural schools have access to experienced educators—students display improved literacy, numeracy, and overall academic achievement. This underlines the need for policies that promote fair teacher deployment, including as incentive programs for rural postings and professional development support, to overcome the educational gap between urban and rural schools in the Volta Region.

Research findings revealed that infrastructural development had a significant effect on student educational attainment in rural parts of the Volta Region, Ghana. School infrastructure, including classrooms, libraries, laboratories, sanitation facilities, and power, has a critical role in defining the learning environment and student achievement. Studies e.g., Amponsah & Boateng, 2022; Fagbohunka, 2017; Adebayo and Jolaosho, 2022; John and Aliyu, 2022 have revealed that schools with inadequate infrastructure generally struggle with overcrowded classrooms, poor ventilation, insufficient learning resources, and lack of current teaching tools, all of which severely effect student engagement and academic attainment. In contrast, well-developed infrastructure promotes the quality of education by providing students with a pleasant learning environment, raising attendance rates, and encouraging improved teacher-student interaction (Okoroma, Edo and Okonko, 2022; Nehemiah, 2022). For example, access to power and digital resources enables for the incorporation of technology into instruction, which has been related to enhanced comprehension and retention of knowledge. Moreover, appropriate sanitation and water facilities reduce absenteeism, especially among female students (Nehemiah, 2022). The findings underline the requirement of government and stakeholder investment in infrastructure development to bridge the rural-urban educational gap and ensure that students in the Volta Region reach greater educational outcomes.

Research findings suggested that government funding had a considerable effect on student educational attainment levels in rural parts of the Volta Region, Ghana. Adequate government funding is vital for providing quality education, since it ensures the availability of essential resources such as well-trained teachers, modern facilities, instructional materials, and student support programs. In rural areas, where financial constraints often hinder educational progress, increased government investment can help bridge disparities by improving school facilities, recruiting and retaining qualified teachers, and providing scholarships or financial aid for students from low-income backgrounds (Mensah & Addo, 2022; Abdul-rahaman *et al.*, 2018). Studies e.g., Abdul-rahaman *et al.*, 2018; Nyakoe, 2020; Bara *et al.*, 2022 have indicated that schools with higher government financing tend to have better academic achievement, as children benefit from enhanced learning environments, access to instructional materials, and well-maintained school buildings. Conversely, inadequate funding often causes in substandard infrastructure, instructor shortages, and limited access to textbooks and technology, all of which significantly affect student learning outcomes. Therefore, consistent and fair government funding is vital for boosting educational achievement in rural Ghana, particularly in the Volta Region, where resource constraints continue to pose hurdles to quality education.

4.1. Implications

The findings that teacher distribution, infrastructure development, and government funding greatly affect student educational attainment in rural areas of the Volta Region, Ghana have several practical implications. First, policymakers and educational officials must develop targeted interventions to ensure the equitable distribution of qualified teachers in rural schools. This may involve offering incentives such as higher salaries, housing allowances, or job advancement chances to encourage teachers to work in underserved areas. Second, increased investment in school infrastructure— such as well-equipped classrooms, libraries, and sanitation facilities—can create a more conducive learning environment, directly improving student performance. Furthermore, government funding must be distributed efficiently to ensure that rural schools receive adequate financial support for teacher training, educational materials, and modern teaching technologies. Non-governmental organizations (NGOs) and private sector partnerships can also play a vital role in supplementing government efforts by providing funding and resources to bridge existing gaps. Addressing these factors through strategic policies and investments will help improve educational results and reduce the urban-rural divide in Ghana's education system.

From a theoretical perspective, the results support the Education Production Function (EPF) Theory, which posits that student educational attainment is determined by key inputs such as teacher quality, infrastructure, and financial resources (Hanushek, 1979). The study's results provide empirical support for the EPF framework by demonstrating how variations in these inputs greatly impact learning outcomes. Specifically, the results validate the theory's assumption that growing resource allocation—such as improving teacher distribution, enhancing infrastructure, and increasing government funding—leads to higher student achievement. Additionally, the study shows the importance of considering contextual factors, such as geographical disparities, when applying the EPF model in policy formulation. By integrating these findings, future studies can further refine the EPF framework to incorporate rural education challenges and suggest tailored solutions for improving student attainment in underprivileged areas.

5. Conclusion and Recommendations

This study examined the impact of teacher distribution, infrastructure development, and government funding on student educational attainment levels in rural areas of the Volta Region, Ghana. The findings suggest that these three factors are critical in shaping student academic performance. Unequal teacher distribution, poor infrastructure, and inadequate government funding have been named as key challenges affecting educational attainment in rural areas. The study supports the Education Production Function (EPF) Theory, which stresses that the availability and quality of educational inputs determine student results. Addressing these disparities is important for improving education in the region and bridging the gap between urban and rural schools. If policymakers and stakeholders implement strategic interventions, students in rural areas can achieve higher academic success, eventually adding to national development. Based on the findings the study recommended that:

- The government should adopt policies that ensure an equitable distribution of qualified teachers across rural and urban schools. Incentive programs, such as hardship allowances, housing support, and career development opportunities, should be introduced to attract and keep teachers in rural areas.
- Investments should be made in building and keeping well-equipped classrooms, libraries, laboratories, and sanitation facilities. Special focus should be given to integrating technology into education by giving rural schools electricity, internet access, and digital learning tools.

- The government should give more financial resources to rural schools to enhance teacher training, buy instructional materials, and upgrade school facilities. Scholarships and financial aid should also be given to students from disadvantaged backgrounds to improve retention and completion rates.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest.

References

[1] Abdul-rahaman, N. et al. (2018) 'The Impact of Government Funding on Students ' Academic Performance in Ghana', International Education Studies, 11(7), pp. 83–91. doi: 10.5539/ies.v11n7p83.

[2] Adebayo, Z. A. and Jolaosho, R. A. (2022) 'Influence of School Infrastructural Development on Teaching and Learning Process towards Enhancing Students ` Academic Performance in Olorunda Local Government Area of', Asian Journal of Advanced Research and Reports, 19(1), pp. 20–28.

[3] Adelman, C., et al., (2014). The Degree Qualifications Profile: A Learning-Centered Framework for What College Graduates Should Know and Be Able to Do to Earn the Associate, Bachelor's or Master's Degree. Lumina Foundation for Education. Accessed from https://eric.ed.gov/?id=ED555847

[4] Adshead, D., et al. (2019). Delivering on the Sustainable Development Goals through long-term infrastructure planning. Global Environmental Change, 59, p.101975. Accessed from https://www.sciencedirect.com/science/article/pii/S0959378019303383

[5] Anlimachie, M. A. (2015) 'Towards Equity in Access and Quality in Basic Education in Ghana: Comparative Strategies for the Rural and Urban milieu', American Journal of Social Issues and Humanities, 5(2), pp. 400–426.

[6] Azi, A. S. and Usman (2022) 'Influence of government funding on teaching in public secondary schools in Pankshin Local Government Area of Plateau State, Nigeria', Sapientia Foundation Journal of Education, Sciences and Gender Studies, 5(1), pp. 43–49.

[7] Bara, D. O. et al. (2022) 'Effect of Government Funding on the Performance of Public Universities in North Central Region of Nigeria 1 Introduction', International Journal of Economics and Management Systems, 7, pp. 366–377.

[8] Barbera, S.A., et al. (2020). Review of undergraduate student retention and graduation since 2010: Patterns, predictions, and recommendations for 2020. Journal of College Student Retention: Research, Theory & Practice, 22(2), pp.227-250. Accessed from https://journals.sagepub.com/doi/abs/10.1177/1521025117738233

[9] Becker, S.L., (1998). Re-thinking the educational production function paradigm. The University of Texas at Austin.

[10] Bello, U. (2021) 'The effects of teachers ' factor on students performance in the final examinations in Abuja (FCT), Nigeria', Journal of Global Social Sciences, 2(7r), pp. 51–69. doi: 10.31039/jgss.v2i7.25.

[11] Bohnenkämper, R., et al. (2022). Socio-economic development and migration in rural Ghana: report from field research in Amedzofe, Volta Region. Accessed from https://opus4.kobv.de/opus4-uni-passau/frontdoor/index/index/docId/1486

[12] Chirimbana, M., Kashweka, E. and Amunime, S., (2022). Assessing the effectiveness of the remoteness and hardship allowance on teacher retention in Oshana Region in Namibia rural schools: Teachers views. Open Journal of Social Sciences, 11(8), pp.383-397. Accessed from https://www.scirp.org/journal/paperinformation?paperid=127222

[13] Cohen, J. (1988) Statistical Power Analysis for the Behavioral Sciences. 2rd edn. New York: Lawrence Erlbaum Associates, Publishers.

[14] Creswell, J. W. and Creswell, D. J. (2018) Research Design. 5th edn. Los Angeles: SAGE Publications, Inc.

[15] Darling-Hammond, L., et al. (2019). Best practices to recruit and retain well-prepared teachers in all classrooms. Learning Policy Institute. Accessed from https://learningpolicyinstitute.org/sites/default/files/product-files/Leandro_Best_Practices_Recruit_Retain_REPORT.pdf

[16] Deng, Y., et al. (2022). Family and academic stress and their impact on students' depression level and academic performance. Frontiers in psychiatry, 13, p.869337. Accessed from https://www.frontiersin.org/articles/10.3389/fpsyt.2022.869337/full

[17] Elias, A. and Mwila, P. M. (2022) 'Infrastructural challenges influencing academic performance in rural public secondary schools in Iringa District, Tanzania', Journal of Research Innovation and Implications in Education, 6(2), pp. 17–24.

[18] Fagbohunka, A. (2017) 'Infrastructural Facility and the Students' Academic Performance - A Critique', Indonesian Journal of Geography, 49(1), pp. 11–16.

[19] Farrington, C.A., et al., (2012). Teaching Adolescents to Become Learners: The Role of Noncognitive Factors in Shaping School Performance--A Critical Literature Review. Consortium on Chicago School Research. 1313 East 60th Street, Chicago, IL 60637. Accessed from https://eric.ed.gov/?id=ED542543

[20] Fornell, C., and Larcker, D. F. (1981) 'Evaluating structural equation models with unobservable variables and measurement error.', Journal of Marketing Research., 18(1), pp. 39–50.

[21] Gaytos, C.G., Lavilla, I.L. and Cablao, S.C., (2020). The lived experiences of teachers from the special education program of Guiuan North District. International Journal of Scientific Research and Engineering Development, 3(3), p.1248. Accessed from https://www.academia.edu/download/64070946/IJSRED-V3I3P171.pdf

[22] Hair, J. F. et al. (2017) 'Mirror, mirror on the wall: a comparative evaluation of composite-based structural equation modeling methods', Journal of the Academy of Marketing Science. doi: 10.1007/s11747-017-0517-x.

[23] Hair, J. F. et al. (2022) A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM). 3rd edn. Thousand Oaks: Sage.

[24] Hanchane, S. and Mostafa, T., (2012). Solving endogeneity problems in multilevel estimation: an example using education production functions. Journal of applied statistics, 39(5), pp.1101-1114. Accessed from https://www.tandfonline.com/doi/abs/10.1080/02664763.2011.638705

[25] Hanushek, E.A., (1979). Conceptual and empirical issues in the estimation of educational production functions. Journal of human Resources, pp.351-388. Accessed from https://www.jstor.org/stable/145575

[26] Henseler, J., Ringle, C. M. and Sarstedt, M. (2015) 'A new criterion for assessing discriminant validity in variance-based structural equation modeling', Journal of Academic Marketing Science, 43, pp. 115–135. doi: 10.1007/s11747-014-0403-8.

[27] Hulland, J. (1999) 'Use of partial least squares (PLS) in strategic management research: a review of four recent studies', Strategic Management Journal, 20, pp. 195–204. doi: 10.1002/(SICI)1097-0266(199902)20:2<195::AID-SMJ13>3.0.CO;2-7.

[28] John, M. O. and Aliyu, U. (2022) 'Educational Infrastructure and Its Impact on Academic Performance in Nigerian Schools', Iconic Research and Engineering Journals, 8(6), pp. 497–502.

[29] Kaiser, N. and Barstow, C.K., (2022). Rural transportation infrastructure in low-and middle-income countries: a review of impacts, implications, and interventions. Sustainability, 14(4), p.2149. Accessed from https://www.mdpi.com/2071-1050/14/4/2149

[30] Karpenko, L., et al. (2021). The growth of the country's economic security level based on the investment infrastructure development projects. Entrepreneurship and Sustainability Issues, 8(4), p.713. Accessed from https://search.proquest.com/openview/8999a455525633f1d781db72ec996a8f/1?pq-origsite=gscholar&cbl=4916366

[31] Klein-Collins, R., (2012). Competency-Based Degree Programs in the US: Postsecondary Credentials for Measurable Student Learning and Performance. Council for Adult and Experiential Learning. Accessed from https://eric.ed.gov/?id=ED547416

[32] Kline, R. B. (2011) Principles and Practice of Structural Equation Modeling. 3rd edn. New York: The Guilford Press.

[33] LaFave, R.R., (2020). A Qualitative Study of the Preparedness of Novice Teachers to Teach Effectively in a Blended Learning Environment. Lindenwood University. Accessed from https://search.proquest.com/openview/32d381bc3e21bae582e758fb9ab5a338/1?pq-origsite=gscholar&cbl=18750&diss=y

[34] Larsen, B., et al. (2020). The effect of occupational licensing stringency on the teacher quality distribution (No. w28158). National Bureau of Economic Research. Accessed from https://www.nber.org/papers/w28158

[35] Lufumpa, C.L. and Yepes, T., (2017). Rapid urbanization and the growing demand for urban infrastructure in Africa. In Infrastructure in Africa (pp. 89-110). Policy Press.

[36] Mason-Williams, L., (2015). Unequal opportunities: A profile of the distribution of special education teachers. Exceptional Children, 81(2), pp.247-262. Accessed from https://journals.sagepub.com/doi/abs/10.1177/0014402914551737

[37] Morgan, A.K., et al. (2022). "We were girls but suddenly became mothers": Evaluating the effects of teenage motherhood on girl's educational attainment in the Volta Region. Cogent Social Sciences, 8(1), p.2036312. Accessed from https://www.tandfonline.com/doi/abs/10.1080/23311886.2022.2036312

[38] Morris, R. J., Muchira, J. M. and Dobrowolski, C. E. (2022) 'Assessing Effects of Government Funding on University Policy- An Institutional Theory Perspective', Higher Education Studies, 13(4), pp. 25–39. doi: 10.5539/hes.v13n4p25.

[39] Muthengi, A. and Romata, S. (2022) 'Effects of Teachers' Distribution and Transfer on Student's Academic Performance in Public Day Secondary Schools in Naivasha Sub-County, Kenya', African Journal of Empirical Research, 4(2019), pp. 505–511.

[40] Nehemiah, N. C. (2022) 'Infrastructural Facilities and Academic Performance of Students in Imo State University, Owerri', International Journal of Research and Innovation in Social Sciences, 7(9), pp. 1568–1583. doi: 10.47772/IJRISS.

[41] Nyakoe, J. N. (2020) 'Influence of Government Funding on Academic Achievement of Public Secondary Schools in Nyamaiya Division , Nyamira County , Kenya', International Journal for Innovation Education and Research, 8(1), pp. 1–8.

[42] Odhiambo, K.S., (2020). Critical success factors for timely completion of World Bank projects in Kenya (Doctoral dissertation, Strathmore University). Accessed from https://su-plus.strathmore.edu/server/api/core/bitstreams/998dab62-aa2b-4a4c-aa05-1507b54bbf71/content

[43] Ojeleye, Y. C., Abu-Abdissamad, A. M., et al. (2022) 'Academic resilience and self- efficacy as predictors of students' academic performance in Nigeria', Sokoto Journal of Management Studies, 32(3), pp. 97–112.

[44] Ojeleye, Y. C., Kareem, R. F., et al. (2022) 'Perceived organisational justice and employee commitment: The role of organisational trust among academic staff in Nigeria', Gusau Journal of Business Administration, 1(2), pp. 1–15.

[45] Ojeleye, Y.C., Mustapha, H.A., et al.,(2022). Brand image, customer satisfaction and consumer purchase intentions in the banking sector of Nigeria: Can service quality strengthen the relationship. Izvestiya Journal of Economics, Management and Informatics, 67(2), pp.110-124. Accessed from https://www.ceeol.com/search/article-detail?id=1166318

[46] Ojeleye, Y.C., Ojeleye, C.I., et al. (2022). Proactive personality and entrepreneurial intentions among Nigerian students: Moderating role of perceived institutional support. Oeconomica Jadertina, 13(1), pp.19-34.Okoroma, N. S., Edo, B. and Okonko, S. C. (2022) 'Influence of Infrastructural Facilities on Academic Performance of Adult Learners in Non-Formal and Adult Education Centers in Rivers State', International Journal of Research Publication and Reviews, 3(7), pp. 3367–3373.

[47] Olurotimi, O. J., Olusola, A. J. and Ekere, S. C. O. (2015) 'Teacher's distribution pattern as determinants of effective teaching and learning in Nigeria Secondary Schools', International Journal of Science and Research, 4(5), pp. 2383–2386.

[48] Oluwatoyi, O. O., Isaiah, A. O. and Awusah, I. B. (2022) 'Influence of some teachers' variables on academic achievement in biology among secondary school girls in Ibadan North Local Government area of Oyo State, Nigeria', British Journal of Education, Learning and Development Psychology, 6(3), pp. 25–36. doi: 10.52589/BJELDP-RDTEMIPY.

[49] Organization for Economic Co-operation and Development (OECD, 2019) Infrastructural Development. Accessed from https://www.oecd.org/en/topics/sub-issues/infrastructure-and-development.html

[50] Qin, L. and Bowen, D.H., (2019). The distributions of teacher qualification: A cross-national study. International Journal of Educational Development, 70, p.102084. Accessed from https://www.sciencedirect.com/science/article/pii/S0738059318304723

[51] See, B.H., et al. (2020). Teacher recruitment and retention: A critical review of international evidence of most promising interventions. Education Sciences, 10(10), p.262. Accessed from https://www.mdpi.com/2227-7102/10/10/262

[52] Sekaran, U. and Bougie, R. (2016) Research Method for Business: A Skill Building Approach. 7th edn. Chichester: John Wiley & Sons Ltd.

[53] Wildschut, A. and Megbowon, E. (2020) 'Impact of funding on academic performance: An exploration of two South African universities', Journal of Education, (81), pp. 31–49. doi: 10.17159/2520-9868/i81a02 Impact.