Impact of Professional Development Programmes on Teachers’ Knowledge and Academic Performance of Senior High School Students in Ghana

Benedict Osei-Owusu

ABSTRACT

To improve educational outcomes through improvements in teaching standards, the Ministry of Education has stepped up efforts aimed at providing continuous and lifelong learning among Ghanaian teachers. However, the impact of the recent emphasis on a comprehensive framework for the professional development of teachers on teaching and learning outcomes has not been adequately studied. Despite the growing body of literature suggesting that professional development and professional knowledge may be associated with student outcomes, these relationships remain an open question. This study, therefore, sought to determine the impact of teachers’ professional development on academic performance in senior high schools in Ghana and the mediating role of teachers’ professional knowledge. A survey was conducted, and valid questionnaires were retrieved from 4,102 teachers in selected public senior high schools from four regions (including 77 districts and 97 public senior high schools) across the Southern, Middle, and Northern belts of Ghana. The results of the study showed that professional development has a significant positive relationship with professional knowledge (γ = 0.26, p < 0.001). Also, professional development and professional knowledge were positively related to academic performance (γ = 0.08, p < 0.001) and (γ = 0.04, p < 0.001) respectively. Finally, the results of the study showed that professional knowledge partially mediated the relationship between professional development and academic performance. The study, therefore, concluded that professional development leads to improvements in the academic performance of students through improvements in teachers’ professional knowledge and other characteristics of teachers that were not accounted for by this study. Among other things, the study recommends that teachers should be encouraged to engage in diverse professional development activities that respond to the inadequacies in their professional competencies.

Keywords: Academic Performance, Ghana, Professional Development Programmes, Senior High School Students, Teachers’ Knowledge

I. INTRODUCTION

Since the turn of the century, teachers’ professional development has gotten a lot of attention, and it’s been considered as a continual process of delivering timely and carefully designed experiences and opportunities to ensure the professional growth and development of teachers (Cochran-Smith & Lytle, 2001; Cordingley et al., 2015; Villegas-Reimers, 2003; Walter & Briggs, 2012). Teachers’ professional development has traditionally been limited to short activities (such as workshops and seminars) aimed at providing new knowledge to teachers about certain aspects of their work. Such an approach to professional development among teachers is not only unproductive in improving teaching and learning outcomes, but it also fails to influence teacher attitudes and practices in the majority of cases (Darling-Hammond et al., 2017; Dunst et al., 2015; Sims & Fletcher-Wood, 2021).

However, the professional development of teachers has since evolved. Several years of studies and recent meta-reviews have led educational researchers to conclude that for professional development to yield results, it should be collaborative, subject-specific, practice-driven, sustained, and draw on relevant stakeholder buy-in and expertise (Cordingley et al., 2015; Dunst et al., 2015; Walter & Briggs, 2012). It follows from this conclusion, therefore, that teachers require ongoing and appropriate training to be able to incorporate evidence-based methods into their teaching, enhance the quality of instruction given to students and improve educational outcomes (Didion et al., 2020). In light
of this, contemporary educational reforms in most countries have reconsidered redefining what constitutes professional development of teachers and provided broad and more comprehensive frameworks for delivering professional development programmes for teachers (Sancar et al., 2021; Valtonen et al., 2017). This shift towards adopting comprehensive teacher professional development programmes has been touted by educational scholars as fostering the notion of teaching as a profession (Darling-Hammond et al., 2017; Sims & Fletcher-Wood, 2021; Villegas-Reimers, 2003).

In Ghana, for example, the Ministry of Education released a national framework for teacher professional development in 2020 through the National Teaching Council (NTC) to oversee the design and execution of professional development programmes for teachers in the country (NTC, 2020). Under this new framework, individual teachers bear the responsibility of participating in relevant professional development activities and keeping records of same for not only building their professional competencies but also as a requirement for rising through the professional ranks or maintaining their status as professional teachers in Ghana (NTC, 2020). Consequently, licensed teachers have a period of three years to earn a rank-specific minimum number of credit points which are awarded based on the number and quality of professional development programmes attended over the three years (NTC, 2020). Also, the NTC published a list of approved programme that qualify as professional development programmes and criteria under which additional programmes may be accepted as contributing to the professional development of teachers in the country. This reform is in line with the consensus in the literature on the need to regard teacher professional development as a continuous and comprehensive process that considers the individual teacher as the most significant change agent in the educational system (Cordingley et al., 2015; Dunst et al., 2015; Sancar et al., 2021; Sims & Fletcher-Wood, 2021; Villegas-Reimers, 2003). It remains to be seen, however, if Ghana's recent focus on teacher professional development enhances the teaching and learning process and, as a result, improves student achievement.

A. Statement of the Problem

The somewhat poor academic performance of Senior High School (SHS) students in national examinations has sparked public outrage in recent years (Abreh et al., 2018; Anamuah-Mensah et al., 2004). In 2015 for example, only 23.63% and 25.29% of SHS students who took the West African Senior Secondary Certificate Examination (WASSCE) obtained the A1-C6 pass grades in Integrated Science and Core Mathematics respectively. In the subsequent year, the statistics weren’t impressive as well. Only about 32% of students obtained the A1-C6 pass grades in core subjects and as many as 38.10% of the students obtained grade F9 (Fail) in at least one core subject. Poor teaching standards, as seen in the absence of regular in-service training and low monitoring of Ghanaian teachers, have been identified as a key contributor to students’ poor academic performance (Abreh et al., 2018; Hervie & Winful, 2018).

To improve educational outcomes through improvements in teaching standards, the Ministry of Education through agencies like the Ghana Education Service and the National Teaching Council have in recent years stepped up efforts aimed at providing continuous and lifelong learning among teachers. This led to the development of the national framework for the professional development of teachers in 2020. However, the impact of the renewed emphasis on continuous professional development on the teaching and learning process has not been studied adequately. It remains unknown whether the participation of Ghanaian teachers in professional development activities influences their delivery in senior high schools and the performance of SHS students.

Despite the growing body of literature suggesting that professional development and professional knowledge may be associated with student outcomes, these relationships remain an open question (Burroughs et al., 2019). It is, therefore, necessary to explore this gap to provide a preliminary understanding of the impacts of professional development programmes on teaching and learning in Ghana. Such an understanding will give policymakers and educational administrators an empirical basis to assess whether the recent reforms in the professional development of teachers could be a game-changer.

B. Research Objective

The study sought to determine the impact of teachers’ professional development on academic performance in senior high schools in Ghana and the mediating role of teachers’ professional knowledge.

C. Research Questions

The study set out to provide answers to the following pertinent questions:

1. What is the relationship between professional development and teachers’ professional knowledge?
2. What is the relationship between professional development and students’ academic performance?
3. What is the relationship between professional knowledge and students’ academic performance?
4. Does teachers’ professional knowledge mediate the relationship between professional development and students’ academic performance?

D. Research Hypotheses

H1: number of professional development programmes positively affects teachers’ professional knowledge.
H2: number of professional development programmes positively affects students’ academic performance.
H3: teachers’ professional knowledge positively affects students’ academic performance.
H4: teachers’ professional knowledge mediates the relationship between the number of professional development programmes and students’ academic performance.

II. Literature Review

A. Professional Development of Teachers

Educational researchers have for years investigated what sets the professional development of teachers apart from other professional development activities. Amidst some marginal disagreements, the evidence in the literature points to six essential features of the professional development of...
teachers which have been shown to produce results or lead to improvements in educational outcomes. These features of effective professional development of teachers are the focus of this section of the review as discussed below.

First of all, the professional development of teachers is considered to be effective if it is subject-specific (Cordingley et al., 2015; Dunst et al., 2015; Wei et al., 2009). That is, it must involve training teachers in subject-specific knowledge. This is a shift from the long-held tradition of providing teachers with training in some pedagogical skills without the specific content with which they are expected to use skills (Sims & Fletcher-Wood, 2021).

Secondly, for the professional development of teachers to be hugely effective it must be sustainable (Blank & de las Alas, 2009; Cordingley et al., 2015; Walter & Briggs, 2012). Since it takes time for teachers to incorporate new knowledge into practice scholars recommend that professional development programmes should be held in cycles or revisited at regular periods as opposed to one-time events which are often not effective (Sims & Fletcher-Wood, 2021).

Thirdly, another important element that makes professional development for teachers effective is how well they relate with the purpose of the programmes and to what extent they are willing to participate in it (Timperley et al., 2007; Walter & Briggs, 2012). That is to say that professional development activities are more likely to be effective if they are voluntary or when teachers understand their benefits for them even if they are mandatory (Cordingley et al., 2015; Dunst et al., 2015; Timperley et al., 2007).

The fourth element considered as essential for the success of the professional development of teachers is the extent of collaboration among teachers who are involved (Cordingley et al., 2015; Timperley et al., 2007; Walter & Briggs, 2012). It is widely acknowledged that when teachers have the opportunity to challenge themselves and share ideas in groups as peers, they tend to learn better than when there is the transfer of information from a session leader without much room for interactions among teachers (Dunst et al., 2015).

Similar to the fourth element of effective professional development programmes for teachers, the fifth feature requires that teachers do not only receive information from trainers but also have the opportunity to practice what is learned (Blank & de las Alas, 2009; Dunst et al., 2015; Kamasah, 2020; Walter & Briggs, 2012). Programmes that involve lectures where teachers only receive information with no simulation exercises or practicing what is learned under classroom situations are touted to be ineffective (Sims & Fletcher-Wood, 2021).

Finally, professional development is seen to be more effective if it sources external expertise (Cordingley et al., 2015; Dunst et al., 2015; Wei et al., 2009). This is particularly essential since it is likely for familiar ideas to be recycled over and over again and so it is always important for school management to seek fresh ideas from people outside the particular school or context (Sims & Fletcher-Wood, 2021).

B. Overview of the Ghana National Teachers’ Professional Development Framework

The National Teaching Council (NTC) of Ghana developed the Teachers’ Professional Development (PD) Framework, which recognizes a teacher's duty and commitment to becoming a competent and relevant practitioner (NTC, 2020). Teachers, Education Directors, Teacher Education Service Providers, and other stakeholders will be guided by this framework to provide appropriate teacher training programmes for in-service teachers. The Framework has identified a variety of tasks that have been categorized as mandatory, ranked-based, or recommended. The suggested exercises are further divided into groups depending on their difficulty and level of teacher engagement.

As a result, teachers at specified levels will have access to both mandatory and ranked-based Training activities. Furthermore, teachers must select any of the recommended training categories to satisfy a needed PD point at that level in a three-year PD cycle. There are two levels of training available from the employer for teachers. That is either at the school level through Professional Learning Communities-PLC, Community of Practice-CoP (Workshop for Heads of Institutions or School Improvement Officers (SIO) or teachers for a specific subject or class (BS3, BS1, KG2) or teachers assigned with common roles and responsibilities.

Teachers may also utilize their portals to access PD activities designed and implemented by other private providers who have been accredited to design and implement PD activities for teachers. Similarly, non-governmental organizations and development partners working with the Ministry of Education are eligible to collaborate with District Education offices to provide teachers with supply-driven programmes.

C. Impact of Professional Development on Teachers Knowledge and Skills

The literature on the impact of professional development programmes on participating teachers reveals a wide variety of benefits for teachers who engage in those activities. Some authors have found that participation in professional development programmes has led some teachers to drop negative perceptions about non-dominant students and reconsidered their classroom management skills (Lee et al., 2007; Messiou & Ainscow, 2015). Other authors found that participation in professional development programmes improved the cultural competence of teachers (Brown & Crippen, 2016; Grimberg & Guummer, 2013; Orosco & Abdulrahim, 2017; Powell et al., 2016; Timmons-Brown & Warner, 2016). For instance, it has been shown that participation in professional development enhances teachers’ ability to interact with students in groups and as individuals, able to better understand individual differences among students, and learned how to contextualize teaching and learning using local resources familiar to students, were more able to teach subject content in culturally appropriate ways and developed the confidence in teaching sensitive issues (Brown & Crippen, 2016; Grimberg & Guummer, 2013; Hulan, 2015; Orosco & Abdulrahim, 2017; Powell et al., 2016; Timmons-Brown & Warner, 2016).

Additionally, professional development improves the self-efficacy of teachers, build positive and cordial relationships with teachers, consider diverse sources of teaching and learning material, and developed a deep understanding of their inefficiencies and biases (Dimitriadou et al., 2012; Katz et al., 2010; Schroeder et al., 2013; Smith & Bahr, 2014;
Timmons-Brown & Warner, 2016). A recent survey among Physics tutors in a Ghanaian College of Education found that professional development was perceived by the tutors as having a great impact on their teaching practice (Coffie, 2019). It is clear from the above studies that participation in professional development activities positively influences the professional knowledge, attitudes, and skills of teachers. However, whether such gains in teacher characteristics lead to improvements in students’ academic performance is an ongoing debate (Burroughs et al., 2019).

D. Impact of Professional Development on Students Academic Performance

A review of the literature shows that very few studies have assessed the impact of professional development programmes on students’ academic outcomes. There so far mixed results on the impact of professional development on students’ academic performance. While most studies have reported positive impacts of professional development programmes on students’ performance, others have found negative or no impacts. For instance, García & García (2016) examined the effects of a classroom action research project on students’ performance in cultural writings and found significant improvement in the performance of students as a result of the project. Also, Johnson & Fargo (2014) found that the proficiency rates of elementary students in schools where teachers participated in a 2-year professional development programmes increased from 25% to 67% while students of teachers who did not participate in the programmes improved from 18% to 29%.

Moreover, two studies found significant improvement in students’ proficiency in reading and mathematics (Mette et al., 2016; Powell et al., 2016). These findings confirmed the results of an earlier review in which 16 studies were found to have reported a significant positive relationship between professional development and academic performance (Blank & de las Alas, 2009). In a similar vein, a recent meta-analytic review found that professional development had a significant, positive effect on the performance of students (Didion et al., 2020). They further observed that moderators did not explain the difference in the effects of professional development on students’ achievements across studies. Additionally, Amirí (2021) found a significant positive relationship between professional development and academic performance, confirming the position of the earlier reviews.

However, some studies have reported that professional development does not always lead to improvements in students’ achievement. For instance, it was found that even after participation in professional development for two years, the performance of students in science dropped from 64.5% to 48.3% (Mette et al., 2016). Additionally, Grimberg & Gummer (2013) found that after three years of an intensive professional development programmes, students in the treatment group did not have a significant gain in scores compared to the control group. Also, there is very limited evidence to link participation in professional development with its effectiveness (Burroughs et al., 2019). The mixed results and paucity of research on the impact of professional development on academic performance in Ghana call for more research in the area to contribute to the ongoing discussion among educational scholars.

E. Teacher Professional Knowledge and Academic Performance

Another relationship that has received some attention among educational researchers in recent times is the relationship between teacher professional knowledge or competence and the level of achievement among students. There is a growing body of literature pointing to a positive association of teacher professional knowledge with academic performance. It is important to note that there is a distinction between general content knowledge and pedagogical knowledge, each of which may influence student outcomes (Baumert et al., 2010; Burroughs et al., 2019). Authors in the United States for example have presented evidence to show that students’ scores in Mathematics are positively associated with the cognitive skills of teachers (Chingos & Peterson, 2011; Clotfelter et al., 2006; Constantine et al., 2009; Shul & Trivitt, 2015). Also, studies from Germany (Baumert et al., 2010), Nigeria (Olasehinde-Williams et al., 2018), and Peru (Metzler & Woessman, 2012) have found that teacher content knowledge is positively associated with student performance. Additionally, professional knowledge is associated with content preparation (Schmidt et al., 2017) and instructional quality (Blomeke et al., 2016), suggesting that the quality of instruction received may influence students’ performance (Burroughs et al., 2019).

However, the above studies are not universal since some pieces of evidence have been presented to the contrary. Some studies have found a very weak or limited association between elements of professional knowledge and academic achievement. Luschei and Chudgar (2011) and Gustafsson and Nilson (2016) for instance, only found a very weak relationship between elements of teacher professional knowledge and students achievement. This confirmed the results of an earlier review that found that only a very low correlation exists between teacher characteristics and student achievement (Wayne & Youngs, 2003). Moreover, two recent studies have found that only some aspects of teacher professional knowledge explained a significant aspect of academic achievement (Gess-Newsome et al., 2019; Liepertz & Borowski, 2019).

In a different light, some studies have reported statistically non-significant relationships between the professional knowledge of teachers and academic performance (Blazar, 2015; Garet et al., 2015; Rockoff et al., 2011). Additionally, a recent study that examined the relationship between the professional competency of lecturers in Indonesian higher education and students’ academic performance found no significant relationship between the two variables (Prasetto et al., 2017). The lack of convergence of the evidence on the relationship between teacher professional knowledge and academic performance makes the current study particularly interesting.

F. Theoretical Foundation

The theoretical viewpoint of metacognitive processes and learning is the source of motivation for this work. Metacognition is a component of self-regulated learning (Postholm, 2012). In the context of this study, this refers to teachers learning how to learn as opined by Postholm (2012). According to Dewey (1916), people who participate in personal development activities learn how to learn and impact
others. When teachers use metacognitive strategies, the purpose is not to achieve some set goals, but rather to examine how to set goals can be or have been satisfied (Postholm, 2012).

Metacognitive knowledge has been divided into two by Flavell (1979, 1987) to include knowledge about one’s self and knowledge about tasks and strategies. By knowledge about a person, Flavell (1979, 1987) meant how one understands himself or herself as a learning and thinking person. Also, knowing about tasks means that one is aware of various cognitive tasks and how they require varying solutions. Moreover, knowledge about strategies includes the learner’s knowledge about various techniques that can be applied to accomplish a task. In the context of the school, this implies how teachers develop a metacognitive attitude toward their teaching practices and how those influences learners (Postholm, 2012).

Based on this theoretical perspective and the available empirical evidence, the researcher hypothesizes a three-factor mediational mediation model (see figure 1) in which participation in professional development programmes positively influences students’ academic performance through improvement in teachers’ professional knowledge in a modern educational context. The researcher has therefore put forward four hypotheses; three of which involve direct relationships among the study variables and one that predicts a mediation effect of teachers’ professional knowledge on the relationship between the professional development of teachers and the academic performance of students.

![Diagram](Fig. 1. Hypothesized mediation model. Note: TPD= Teacher Professional Development, PK= Professional knowledge, AP= Academic Performance)

III. METHODOLOGY

A. Research Design

This research used a correlational design because it wanted to look at relationships among variables measured on a quantitative basis (Creswell, 2018). The approach adopted for this study is a mediational approach in which the researcher examined the impact of professional development programmes on students’ academic performance through teachers’ professional knowledge.

B. Participants

A survey was administered to teachers in selected public senior high school (SHS) teachers in four regions across the Southern, Middle, and Northern belts of Ghana. The SHSs were randomly selected from a list of all public schools in the selected regions and all teachers in the selected schools were invited to take part in the study. A total of 4,327 questionnaires were distributed to teachers who expressed interest in the study; a total of 4,102 valid questionnaires were retrieved, resulting in a response rate of 94.8%. Additional details on the participating teachers have been given in Table I below.

<table>
<thead>
<tr>
<th>Region</th>
<th>Number of Districts</th>
<th>Number of Schools</th>
<th>Number of Teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ashanti</td>
<td>34</td>
<td>38</td>
<td>1,189</td>
</tr>
<tr>
<td>Greater Accra</td>
<td>22</td>
<td>29</td>
<td>1,056</td>
</tr>
<tr>
<td>Bono</td>
<td>9</td>
<td>14</td>
<td>984</td>
</tr>
<tr>
<td>Northern</td>
<td>11</td>
<td>16</td>
<td>873</td>
</tr>
<tr>
<td>Total</td>
<td>77</td>
<td>97</td>
<td>4,102</td>
</tr>
</tbody>
</table>

C. Data Collection Tool

A structured questionnaire was employed as the data collection tool for this study. The questionnaire had four sections. The first section had four items on the socio-demographic characteristics of respondents. The second section had a list of all NTC-recommended professional development activities (NTC, 2020). The third section had seven items on teachers’ professional knowledge and the last section on the academic performance of students with one item.

D. Measures

Three main variables were of interest in this study; professional development, teachers’ professional knowledge, and academic performance. Consistent with the study design, all the variables were measured quantitatively. Details on the measures for the three variables are given below.

E. Professional Development

To measure the participation of teachers in professional development activities, all the NTC-recommended professional development activities were provided as part of the questionnaire. Teachers were asked to indicate which of the listed professional development activities they have engaged in within the last 24 months. The activities on the list were randomly assigned and not put in their respective categories. This was done deliberately to reduce social desirability bias; a situation in which teachers select more activities under categories with high points knowing it will enhance their professional development score. The researcher however assigned the category-specific points (NTC, 2020) to each of the activities after data collection. A professional development score was then calculated for each teacher by adding all the individual scores obtained for all the activities selected.

F. Teachers Professional Knowledge

The researcher was also interested in the professional knowledge of teachers within a framework that reflects the 21st-century skill set necessary for good teaching. The combined technological pedagogical content knowledge (TPACK) scale was adopted from Valtonen et al. (2017). The tool was originally developed to assess the views of teachers about using ICT within a modern skills framework and in a pedagogically meaningful manner (Valtonen et al., 2017). In this study, teachers were asked to rate their knowledge on seven items using a five-point Likert scale where 1 = I need
a lot of additional knowledge in this area; 2 = I need some additional knowledge in this area; 3 = I need little additional knowledge in this area; 4 = I have strong knowledge in this area; 5 = I have very strong knowledge in this area. The combined TPACK scale had an original Cronbach’s α of 0.96 (Valtonen et al., 2017) indicating a very strong internal consistency. Due to modifications made to the scale in this study, a Cronbach’s α was estimated and the resulting α of 0.81 indicated a strong internal consistency.

G. Academic Performance

To measure the academic performance of students in the subjects taught by the teachers who responded to the survey, respondents were asked to record the average score of students in their most recent end-of-term examination. To reduce recall bias, teachers were encouraged to refer to their records on the examination. The one week between questionnaire distribution and collection was deemed appropriate to allow for this reference. Moreover, the anonymous nature of the questionnaire was to reduce social desirability bias among the teachers.

H. Data Collection Procedure

Data collection for this study was done between September and December 2021. The researcher made contacts with the selected schools and interacted with the teachers during staff common meetings to explain to them the purpose of the study. Questionnaires were distributed to teachers in the selected schools on separate dates within the data collection period and allowed for one week from the day of distribution to allow the teachers to have enough time to respond to the items and make the necessary references where appropriate. After a week of distribution, the researcher went around with two trained data collection assistants to retrieve the questionnaires.

I. Data Analysis

Data collected were initially entered into Microsoft Excel for data cleaning and transferred into Jamovi software Version 2.2 (The jamovi project, 2021) for further analysis. Frequency tables were generated to describe the socio-demographic characteristics of the teachers. Also, means and standard deviations were estimated to summarize the main variables of the study. Also, Pearson correlation was used to examine the relationships between the three variables as the primary evidence for the discriminant validity of research constructs. Moreover, the measurement model of the TPACK construct was tested using confirmatory factor analysis (CFA) with maximum likelihood estimation. A composite TPACK measure was then developed using the simple averaging method (Song et al., 2013). Finally, a simple mediation analysis with parametric bootstrapping (5000 samples) was carried out to test the hypothesized mediation model.

IV. RESULTS

A. Socio-demographic Characteristics of Respondents

To provide the context for the data collected, the characteristics of respondents were examined and summarized in Table II. The results showed that the majority of the respondents were male (62.1%), had been in service for 3-5 years (36.8%), held a bachelor’s degree as their highest qualification (70.3%), and were aged 31-40 years (49.2%).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Frequency</th>
<th>%</th>
<th>Variable</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td>Qualification</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>2,547</td>
<td>62.1</td>
<td>Bachelor’s degree</td>
<td>2,875</td>
</tr>
<tr>
<td>Female</td>
<td>1,555</td>
<td>37.9</td>
<td>Postgraduate (diploma/certificat e)</td>
<td>664</td>
</tr>
<tr>
<td>Years in service</td>
<td></td>
<td></td>
<td>Postgraduate (Master’s degree)</td>
<td>552</td>
</tr>
<tr>
<td>&lt;3 years</td>
<td>1,066</td>
<td>26.1</td>
<td>Age</td>
<td>552</td>
</tr>
<tr>
<td>3-5 years</td>
<td>1,505</td>
<td>36.8</td>
<td></td>
<td>552</td>
</tr>
<tr>
<td>6-10 years</td>
<td>840</td>
<td>20.5</td>
<td></td>
<td>552</td>
</tr>
<tr>
<td>11-15 years</td>
<td>418</td>
<td>10.2</td>
<td></td>
<td>552</td>
</tr>
<tr>
<td>&gt; 15 years</td>
<td>262</td>
<td>6.4</td>
<td></td>
<td>552</td>
</tr>
</tbody>
</table>

B. Measurement Model Testing

The structure of the teacher professional knowledge construct (TPACK) was tested using CFA. The results of the CFA showed that the hypothesized measurement model had good fit for the data (χ² [14] = 467, p < 0.001; CFI = 0.95; TLI = 0.96; SRMR = 0.052; RMSEA = 0.069). Additionally, all the indicators were significantly loaded onto the professional knowledge construct (see Table III), confirming the convergent validity of the construct (Li et al., 2013).

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Standard Estimate</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>TPACK 1: In teaching the subject I handle, I know how to use ICT as a tool for sharing ideas and thinking together.</td>
<td>0.877</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>TPACK 2: In teaching the subject I handle, I know how to use ICT as a tool for students’ reflective thinking.</td>
<td>0.669</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>TPACK 3: In teaching the subject I handle, I know how to use ICT as a tool for students’ plan their learning.</td>
<td>0.374</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>TPACK 4: In teaching the subject I handle, I know how to use ICT as a tool for students’ problem-solving in groups (2-5 students).</td>
<td>0.866</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>TPACK 5: In teaching the subject I handle, I know how to use ICT as a tool for students’ creative thinking.</td>
<td>0.644</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>TPACK 6: In teaching the subject I handle, I know how to use ICT as a tool in group work (2-5 students).</td>
<td>0.355</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>TPACK 7: In teaching the subject I handle, I know how to use ICT in teaching as a tool for students’ critical thinking.</td>
<td>0.450</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>

Also, correlations among the research variables and descriptive statistics provided primary support for the discriminant validity of the items (Table IV). The results show that there was a significant moderate relationship between professional development and professional knowledge (r = 0.432; p < 0.001). Also, there was a significant moderate relationship between professional knowledge and academic performance (r = 0.469; p < 0.01). Moreover, there was a significant strong relationship between professional development and academic performance (r = 0.727; p < 0.001).
C. Mediation Analysis and Hypothesis Testing

The first hypothesis of the study predicted a positive relationship between professional development and professional knowledge. The path estimates (see Fig. 2.) showed that professional development is positively related to professional knowledge ($\gamma = 0.26, p < 0.001$) and this supports H$_1$. The second hypothesis of the study predicted a positive relationship between professional development and academic performance. The path estimates (see Fig. 2.) showed that professional development is positively related to academic performance ($\gamma = 0.08, p < 0.001$) and this supports H$_2$. The third hypothesis of the study predicted a positive relationship between professional knowledge and academic performance. The path estimates (see Fig. 2.) showed that professional knowledge is positively related to academic performance ($\gamma = 0.04, p < 0.001$), and this support H$_3$.

A mediating analysis of teacher professional knowledge on the relationship between professional development and academic performance was performed to test the final hypothesis of the study. The results (see Table V) revealed that the total effect of professional development on academic performance was found to be significant ($\gamma = 0.09, p < 0.001$). After the inclusion of the mediating variable (professional knowledge), the impact of professional development on academic performance was still significant ($\gamma = 0.08, p < 0.001$). Moreover, the indirect effect of professional development on academic performance through professional knowledge was significant ($\gamma = 0.01, p < 0.001$). This shows that the relationship between professional development and academic performance is partially mediated by professional knowledge, providing support for the fourth hypothesis (H$_4$).

Figure 3 provides a graphical representation of the partial mediation with 95% confidence intervals.

![Fig. 2. Unstandardized pathway coefficients for the mediation model. All estimates are significant ($p < 0.001$).](image)

![Fig. 3. Estimate Plot (indirect, direct, and total effects of professional development).](image)

TABLE V: MEDIATION ESTIMATES (INDIRECT, DIRECT, AND TOTAL EFFECTS)

<table>
<thead>
<tr>
<th>Type</th>
<th>Effect</th>
<th>Effect Estimate</th>
<th>95% CI*</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indirect</td>
<td>TPD $\rightarrow$ PK</td>
<td>0.0103</td>
<td>0.00710 – 0.0135</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>TPD $\rightarrow$ AP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct</td>
<td>TPD $\rightarrow$ AP</td>
<td>0.0808</td>
<td>0.07398 – 0.0877</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Total</td>
<td>TPD $\rightarrow$ AP</td>
<td>0.0911</td>
<td>0.08568 – 0.0965</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

*Confidence intervals were computed with parametric bootstrap method (5000).

V. DISCUSSION

This study set out to contribute to an ongoing discussion on the effectiveness of the professional development of teachers. Previous research had failed to build consensus on the specific impacts of professional development among teachers on their professional knowledge and skills as well as on the academic performance of students. Moreover, such studies were to a large extent inadequate in Africa and Ghana in particular. Finally, the mediating effect of professional knowledge on the relationship between professional development and academic performance had not been examined. In response to these issues raised in the literature, this study was occasioned to provide answers to four pertinent questions which remained open.

First, the study sought to examine the relationship between professional development and professional knowledge. The results of the study showed that professional development has a significant positive relationship with professional knowledge ($\gamma = 0.26, p < 0.001$). It accounted for approximately 26% of the changes in the mean levels of teacher professional knowledge. This result is extraordinarily promising in two main ways. On the one hand, it provides further quantitative evidence to support the position of scholars on the importance of professional development in enhancing the professional knowledge and skills of teachers (Brown & Crippen, 2016; Coffie, 2019; Grimberg & Gummer, 2013; Messiu & Ainscow, 2015; Orosco & Abdulrahim, 2017; Powell et al., 2016; Schroeder et al., 2013; Smith & Bahr, 2014; Timmons-Brown & Warner, 2016). On the other hand, it provides a preliminary understanding of the positive effects of Ghana’s recent emphasis on the sustainable and comprehensive professional development of teachers. Even though the observed relationship in this study is not strong, it should be understood in the context of the fact that professional development among teachers in Ghana has only been recently standardized and made a key component of the teaching practice (NTC, 2020). Over time and as more and more teachers participate in a diverse number of professional development activities, the impacts on their professional knowledge and skills in a modern educational setting are expected to be profound.

Second, the study sought to examine the relationship between professional development and academic performance. The results of the study showed that professional development is positively related to academic performance ($\gamma = 0.08, p < 0.001$). Professional development explained approximately 8% of the changes in academic performance. This result aligns with the plethora of studies...
that have found a positive relationship between professional development and academic performance (Amiri, 2021; Blank & de las Alas, 2009; Didion et al., 2020; García & García, 2016; Johnson & Fargo, 2014; Mette et al., 2016; Powell et al., 2016). However, compared to these studies, the relationship observed in the present study is very weak. For instance, Johnson and Fargo (2014) found a proportional difference of about 31% in favor of students taught by teachers who participated in a two-year professional development programmes in the US. This difference may be explained by the differences in the levels of development between the two countries. This is because systemic challenges which are characteristic of the educational systems in developing countries like Ghana have the potential to derail or delay the realization of the impacts of educational policy (Osei-Owusu, 2021).

Third, the study was also keen on contributing to the body of knowledge on the relationship between professional knowledge and academic performance. Consistent with the findings of several previous studies (e.g. Blomeke et al., 2016; Gess-Newsome et al., 2019; Liepertz & Borowski, 2019; Luschei & Chudgar, 2011; Olasehinde-Williams et al., 2018; Shuls & Trivitt, 2015), the results of the study showed that professional knowledge is positively related to academic performance ($\gamma = 0.04, p < 0.001$). This result, even though significant, shows a very weak relationship between professional knowledge and academic performance. The author cannot conclusively account for such a weak relationship but it can be attributed to the fact that it usually takes time for teachers to incorporate newly learned knowledge into practice (Sims & Fletcher-Wood, 2021) and so may take some time for the realization of the full impacts of the improvements in professional knowledge accounted for by participation in professional development activities.

Finally, the study explored the mediating role of professional knowledge on the relationship between professional development and academic performance through simple mediation analysis. The results showed that professional development had a positive and significant total effect on academic performance ($\gamma = 0.09, p < 0.001$). The results of the study also showed that professional knowledge partially mediated this relationship. What this means is that students benefit both directly ($\gamma = 0.08, p < 0.001$) and indirectly ($\gamma = 0.01, p < 0.001$) from the participation of their teachers in professional development programmes. The significant direct impact of professional development on academic performance revealed by this study implies that the benefits of professional development are not transmitted to students only through improvements in teachers’ professional knowledge but through other aspects of the practice of teachers. For instance, participation in professional development has been shown to improve teacher-student relationships, teacher self-efficacy, cultural competence of teachers, and improved classroom management among teachers (Brown & Crippen, 2016; Lee et al., 2007; Messiou & Ainscow, 2015; Orozco & Abdulrahim, 2017; Powell et al., 2016; Timmons-Brown & Warner, 2016). These could be additional avenues through which the impacts of professional development may be transmitted to students as suggested by (Burroughs et al., 2019) that the quality of instruction received by students may influence their academic performance.

VI. CONCLUSION

The study set out to determine whether teachers’ participation in professional development programmes impacts teaching and learning in senior high schools in Ghana. The study adopted a three-factor mediation model and used a quantitative approach to test four hypotheses on the relationships among professional development, professional knowledge, and academic performance. The results of the study show that the three variables are positively and significantly related to each other, albeit weakly. This study, therefore, concludes that professional development leads to improvements in the academic performance of students through improvements in teachers’ professional knowledge and other characteristics of teachers not accounted for in this study. The recent emphasis of the Government of Ghana on the standardization and institutionalization of professional development of teachers as an essential aspect of the teaching profession is therefore expected to improve academic outcomes over time as more teachers engage in various professional development activities.

VII. IMPLICATIONS FOR THEORY AND RESEARCH

Theoretically, this study has expanded the body of knowledge on the impact of professional development on teaching and learning. First of all, the relationships observed among professional development, professional knowledge, and academic performance contribute to the ongoing discussion on the topic. Also, this study makes a unique contribution to the literature by presenting evidence on the mediating effect of professional knowledge on the relationship between professional development and academic performance. Finally, this study is among the pioneering research efforts in Ghana after the introduction of the new framework for teacher professional development.

However, the results of this study should be interpreted within the context of a few limitations. First, the study’s reliance on self-reported measures of the main variables means there is the possibility for some level of having socially desirable responses on the part of participating teachers. The researcher was not oblivious of this potential threat to the validity of the study and hence took proactive steps to reduce social desirability bias if not prevent it entirely. For instance, the researcher explained to researchers the need, to be honest about their responses considering the benefits of the study to national development. Also, the use of completely anonymized data collection instruments has been long acknowledged as one of the most effective means of reducing social desirability bias among study participants (Nederhof, 1985). Also, the approach used to estimate the total professional development score of participating teachers was not in any way intended to be a substitute for the formulae developed by the NTC (2020). The researcher found that the NTC’s approach was dependent on the rank of teachers since it is meant to be a tool for estimating professional development points to promote teachers or
renew their license and so not appropriate for use in this study since the researcher was not interested in the rank occupied by these teachers.

This study, therefore, has two main implications for future research. First, educational researchers need to examine other characteristics of teachers through which the impacts of professional development are transmitted to students. This could provide useful focus areas for planners of professional development and help educational administrators to critically evaluate professional development activities. Second, more research is needed to provide a continuous assessment of the impacts of teachers’ participation in professional development on the performance of students in specific subject areas, especially in Ghana and other African countries where such research is lacking. Moreover, future research should investigate the challenges faced by teachers in accessing professional development programmes and ways in which school management influences the delivery of professional development for teachers in Ghana.

VIII. RECOMMENDATIONS FOR PRACTICE

Following the results of the study, four recommendations are made for practice:

First, the National Teaching Council and relevant agencies of government like the Ghana Education Service should regularly sensitize teachers on the need to participate in professional development activities to realize the full impacts of such activities on teaching and learning outcomes. This is because the evidence in the literature shows that professional development activities are most likely to be effective when teachers identify with them and understand the benefits to their professional growth and development (Cordingley et al., 2015; Dunst et al., 2015; Timperley et al., 2007).

Second, school management in senior high schools should regularly assess areas of professional knowledge and skills where teachers are lacking and recommend appropriate professional development programmes to bridge such gaps. Such assessments should be transparent and teacher-driven to ensure the specific needs of individual teachers are appropriately diagnosed.

Third, teachers should be reflective enough to understand their inadequacies so they can select and engage in appropriate professional development activities that respond to gaps in their professional knowledge and skills.

Finally, teachers should participate in professional development activities that respond to existing inadequacies in students’ academic performance. Such tailoring of professional development efforts to the needs of students can have significant impacts on students’ academic performance (Burroughs et al., 2019).

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