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Unveiling the Untold Stories of Acquiring a PhD Using Structural Equation Modelling: Ghanaian Perspective

Mary Ann Yeboah[1], Kwame Annin[1], Francis Yaw Anyan[1,*], Ama Pokuah Obeng[2], Rosemary Abayase[3], Elizabeth Serwaa Koomson[4]

[1]Department of Statistical Sciences, Kumasi Technical University, Box 854, Kumasi, Ghana
[2]Department of Computer Science, Kumasi Technical University, Box 854, Kumasi, Ghana
[3]Department of Hotel, Catering and Institutional Management, Kumasi Technical University, Box 854, Ksi., Ghana
[4]Department of Procurement and Supply Chain Management, Kumasi Technical University, Box 854, Kumasi, Ghana
*Corresponding author: anyanfrancis@ymail.com

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Abstract The study examines the relationship between challenging factors and remedial factors effect on attainment of PhD by Ghanaian using structural equation modelling (SEM). The results showed that the majority of the PhD holders acquired a PhD to enhance their careers, specifically to fulfil job requirements. It was also observed that lack of commitment from supervisors, personal problems, and financial limitations were found to be major barriers to attainment of a PhD. These difficulties impair PhD students' mental and physical health, which invariably impedes their academic progress. It was also discovered that although remedial factors such as a positive outlook, effective communication, and supervisory assistance are vital in reducing these difficulties, the quality of the academic and research environment has a major impact on students' PhD achievement. This suggests that a resource-rich and encouraging environment is necessary for PhD programs to be completed on time. These findings are significant for PhD applicants and students as they embark on a PhD academic journey.

Keywords: *PhD, doctorate, challenges, mental health, academia, SEM*

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1. Introduction

A doctor of philosophy (PhD) or terminal degree is the most advanced degree you can earn, symbolising you have mastered a specific area of study or field of profession. Acquiring a PhD is now more crucial in the academic life of a Ghanaian lecturer (teacher) at a tertiary institution than ever before. Currently, the terminal degree is the basic requirement for employment as a teaching staff in any public university in Ghana. Those who were already employed as teaching staff in the public universities before the current requirement was instituted cannot be promoted to their next rank without the PhD. This obviously impedes the progress of those without the PhD to climb to the highest level of professional rank as academic staff of public universities in Ghana. The significance of education is ingrained in Ghanaian culture, and deciding whether to pursue a PhD depends on a variety of considerations that may extend beyond simple academic desire. For example, PhD holders are treated with great respect in society, thus compelling some industries in Ghana to require a PhD in order to occupy some top executive roles. According to Leonard [1] and Gopaul [2], people pursue a PhD primarily to increase their chances of obtaining the highest managerial position and prominence in academia. In assessing the performance of chief executive officers (CEOs) charged with the responsibility of managing organisations, Urquhart and Zhang [3] found that CEOs with PhDs outperform those without. This may explain the recent increase in the number of PhD students in Ghana.

The journey toward acquiring a PhD is often pinnacle as the path marked by intellectual thoroughness, academic achievement, and professional advancement. Nevertheless, this account oversimplifies the complex realities faced by PhD students, particularly in the Ghanaian context. Behind the quest of a PhD lies a mesh of untold stories interlaced with personal aspirations, societal expectations, and institutional challenges that shape and influence the experiences of those who go on this grueling academic journey. Despite the prestige associated with obtaining a PhD in Ghana, the hurdles that a PhD student faces are considerable and must not be overlooked. In certain circumstances, these problems have affected the mental health of some students, leading to some Ghanaian students abandoning their pursuit of a PhD. As a result, the purpose of this article is to investigate the problematic elements that inhibit PhD acquisition and the restorative

aspects that encourage Ghanaians to pursue PhDs. We also examine the importance of the mental wellness of Ghanaian PhD students in the attainment of PhD. The study's findings are going to assist in controlling how PhD students deal with problems that may hamper their effective completion of the PhD, as well as how to manage the complexities of the PhD path. The findings may also prompt university administrators to create a suitable environment that will spark the successful completion of the PhD. Furthermore, it may provide some basic information to assist university counsellors in guiding PhD students who are on the verge of giving up on their quest to obtain a PhD due to pressures arising from the PhD program, which may have an impact on their mental health. To the best of our knowledge, this is the only study that examines the relationship between challenging and remedial factors as well as the mental health of Ghanaian PhD candidates' effect on the attainment of a PhD.

The remaining section is as follows: Section 2 examines the review of relevant studies. Section 3 outlines the procedure, including the sample methodology and model formulation. Section 4 examines the analysis, findings, and discussion. Section 5 discusses further analysis. Section 6 summarises the study's conclusions and recommendations.

2. Related Works

There are so many reasons why people would want to attain a PhD; however, from previous research, some of the motivations for pursuing PhD programs are "Passion for research," "personal fulfilment and intellectual challenge," "career advancement and specialisation," "contribution to society," as well as "academic and teaching opportunities" [4,5]. These recent research works that touched on motivation for pursuing PhD programs are in line with Leonard [1] and Gopaul [2], who emphasised in their works that pursuing a PhD is to enhance their cultural capital or secure positions of authority and influence within academia. They provide important insights into the social and gendered dimensions of doctoral education, highlighting how personal, professional, and social factors influence the decision to pursue and succeed in a PhD program. Mensah [6] discusses that many Ghanaians are driven by a desire to contribute to the body of knowledge in their fields. This is particularly important in disciplines where there is limited local research and scholars feel a responsibility to fill these gaps. Research in Ghana often aims to address societal challenges and contribute to policy development, focusing on the sustainable development goals (SDGs) [7].

Most people would pursue a PhD for self-actualisation, especially for older adults. Keeley & House [8] found in their research that many individuals see the PhD as a way to achieve personal goals and fulfill lifelong dreams of contributing to knowledge in their field of interest. Baker & Lattuca [9] discussed in their study that mid-career professionals often return to academia to pursue doctoral degrees as a way to advance or transition into new roles, particularly in academia or research-intensive positions. A survey by Golde & Dore [10] found that financial stability can be a crucial factor in the decision to embark on a doctoral journey. They found that often older students have more financial stability and life experience, which can help manage the demands of a PhD program more effectively than their younger counterparts.

From the literature, it is evident that men pursue PhD programs more than women due to a number of reasons. According to the National Science Foundation Report (NFS) 2023, there is gender disparity in Science, Technology, Engineering, and Mathematics (STEM) fields, which are essential contributors to the attainment of a PhD. The report showed that while the gender gap is closing in some fields, men still dominate areas like engineering and computer science, which have higher rates of PhD completion. This information by NFS 2023 is consistent with Ceci & Williams [11], who highlight how under-representation of women in STEM fields contributes to overall gender disparity in PhD attainment. Cech & Blair-Loy [12], also, explore how parenthood affects career progression, with women often facing more significant challenges in balancing academic pursuits with family responsibilities impacting their decisions to pursue PhDs. Gender bias in academia may also lead to fewer women pursuing PhDs in some fields due to a lack of support and recognition. Elsevier Gender Report [13] concludes this point with an in-depth analysis of gender disparities in global research output showing that men are more likely to be involved in research leading to PhDs, particularly in fields and countries with less gender equity like Ghana. Ampofo & Boateng [14] show evidence of the gender disparities in PhD attainment in Ghana, similar to global trends. They emphasize the need for more supportive policies and structures to encourage women to pursue and complete PhDs.

According to Atkinson et al. [15], there is an academic acceptance that doctoral studies are a complex or multifaceted endeavour bound with the divergent, developing, and conflicting identities of the students who undertake them. It is perceived that it is the level of education where most students go through so many frustrations that some end up giving up on the way. The human spirit is the seat of all uncertainty; the individual internalizes the tensions of the world, believing these tensions to be their own, and subsequently seeks to escape them without even questioning the reason for the presence of these tensions in their thoughts.

Bluntz [16] reiterates that the mental health of PhD students is indeed starting to receive some attention in academia. Consistent with Barry et al. [17], PhD students have higher levels of depression, anxiety, and stress than the general population. Another study conducted in Flanders has shown that PhD students have a one-in-two chance of developing a mental health problem and a one-in-three chance of developing a psychiatric illness, such as depression. Bluntz [16] hints that this is possibly to be expected since, from the very beginning of the PhD journey, we are inveigled to see our colleagues as competitors rather than as friends and to remember that we will be vying for the same positions in the not-so-distant future. In this way, we become suspicious instead of showing solidarity towards one another, which is unfortunate because it deprives us of a support structure within our own community.

3. Methods

3.1. Sampling Strategy and Data Collection Technique

The sample size for our study was obtained by utilsing the Cochran sample size calculation as stated in equation (1)

$$n = \frac{z^2 PQ}{e^2} \tag{1}$$

where z is the confidence level, which may be found on the z-table for a certain confidence level, e is the margin of error that represents the intended degree of accuracy, and n is the sample size to be taken from the target population. Q is expressed as 1-P, and P is the expected proportion. The stratified random sampling technique was used to sample one hundred (100) PhD holders who were either educated in Ghana or overseas. The procedure for the stratification is as follows: the researchers divided the target population into two categories: academic strata, PhD holders who teach at the tertiary institutions where the basic requirement for lecturing is a PhD, and non-academic strata, PhD holders who work at institutions, companies, or agencies whose core activities are not related to teaching in Ghana. Strata were selected at random from each of the two primary strata: academic strata and non-academic strata. This guaranteed that the focus on PhD holders for our study offers variety, including PhD holders who lecture at the tertiary level of education as well as those with PhDs who work in industry. This resulted in more complete and detailed data gathering. The study's data was collected utilising a Google form-based questionnaire.

3.2. Data Description

Data for the study was obtained using a questionnaire. The questionnaire consisted of two parts. Part one sought information on motivation for PhDs, benefits of PhDs, metal well-being and its effects on acquiring a PhD, challenges and ways of managing these challenges. Part two of the questionnaire consisted of Likert scale questions soliciting information from respondents on the completion process, study delays, causes of delays, supervisor relationship, and commitment. The questionnaire also collected demographic information about the respondent. Cronbach's alpha of 0.87 was recorded for all of the items on the questionnaire for our study, which exceeds the minimum Cronbach alpha of 0.7 regarded as an acceptable reliability coefficient criterion. The questionnaire therefore met the requirements for validity and reliability to be distributed across the statistical population. The data items were twenty-six (26) in all. Out of the twenty-six (26) data items, four (4) were on the demographics of the respondent whilst twenty-two (22) concentrated on questions relating to the objectives of the research. One hundred and five (105) questionnaires were retrieved but one hundred (100) were valid and used for the analysis.

3.3. Model Specification

In order to accomplish the objectives of this study, structural equation modelling (SEM) was employed in the analysis. According to Hair et al. [18], data analysis utilising statistical techniques such as multiple regression, logistic regression, and analysis of variance are examples of "first-generation multivariate data analysis techniques," which primarily investigate correlations between variables under examination. According to these scholars, these methods have been used by several scientists across a wide range of fields to produce results that have profoundly influenced our current understanding of the world. However, Haenlein and Kaplan (2004), indicate that there are three significant drawbacks of the above-mentioned methods, which are: first, they assume a basic model structure; second, all variables must be observable; and third, they assume error-free measurement of all variables. The shortcoming of these traditional methods, according to Hair et al. [18], only makes these approaches useful in situations where there is "no systematic or random error" present in the measured variables. However, this kind of scenario is extremely uncommon in practice, especially in estimating relationships between measurements of theoretical concepts.

A contemporary approach called Structural Equation Modelling (SEM) stands out for its ability to overcome these restrictions. This method has gained popularity in research and has been used to quantify complex interactions between several dependent and independent variables. The SEM evaluates the link between unobservable construct variables using measured variables, often known as indicators, and accounts for measurement error for each measured variable. Hence, according to Cole and Preacher [19], the SEM approach yields a more accurate measurement of the relevant theoretical ideas. As a result of the aforementioned limitations of standard statistical techniques, and given the standout of the SEM approach, this study used SEM to examine the relationship between PhD acquisition, challenging factors, and remedial factors.

3.3.1. Measurement Models

The measurement model in the SEM is the model that links the construct to the measured (indicator) variables. This study comprises eleven measurement models, which are as follows:

$$\begin{aligned}
y_1 &= \beta_1 C + u_1 \\
y_2 &= \beta_2 C + u_2 \\
y_3 &= \beta_3 R + u_3 \\
y_4 &= \beta_4 R + u_4 \\
y_5 &= \beta_5 R + u_5 \\
y_6 &= \beta_6 R + u_6 \\
y_7 &= \beta_7 R + u_7 \\
y_8 &= \beta_8 R + u_8 \\
y_9 &= \beta_9 P + u_9 \\
y_{10} &= \beta_{10} P + u_{10} \\
y_{11} &= \beta_{11} P + u_{11}
\end{aligned} \tag{2}$$

Where C, R and P are the challenge factors, remedial factors and PhD acquisition variables, respectively. Furthermore, the observable variables y_1 and y_2 which represent poor academic research environment and challenge with data acquisition respectively, serve as a proxy for the latent variable, challenge factors. Additionally, y_3, y_4,…, y_8 represent personal attitude, good communication skills, good writing skills, time management skills, areas of expertise and supervisory support, which also measure the construct remedial factors. To sum up, y_9, y_{10} and y_{11} are quality of PhD work, successful completion of PhD, and good performance in the PhD process, respectively, which measure the latent variable PhD acquisition. The error terms for each of the measurement models are u_1, u_2 ,…, u_{11} for each of the measurement models.

3.3.2. Latent Model

The latent models for this study are derived using three latent variables, namely challenge factors, remedial factors, and PhD acquisition, as shown below:

$$R = \delta_{11}C + e_1 \quad (3)$$

$$P = \delta_{21}R + \alpha_{21}C + e_2 \quad (4)$$

Where δ_{11} is the path coefficient linking remedial factors to challenge factors and vice versa, δ_{21} is the path coefficient linking challenge factors to PhD acquisition, and α_{21} is the path coefficient linking remedial factors to PhD acquisition, while e_1 and e_2 are the error terms.

4. Analysis, Results and Discussion

4.1. Background Characteristics of Respondents

The background characteristics of respondents have been categorised and discussed under gender, age, occupation, and motivation to do a PhD, as shown in Table 1.

4.1.1. Gender

From Table 1, it can be seen that the majority (68%) of the respondents are males, while 32% were female. The results, as indicated, show that males dominate those who offered PhD programs across the country. This pattern is in line with global trends [13,20], which show that men are more likely than women to enroll in doctoral programs, especially in STEM fields. UNESCO [21] research shows that although there has been progress in gender parity in education, there are still notable disparities at the PhD level, particularly in specific areas and fields. The high percentage of men in PhD programs may be due to a number of factors, such as career pathways, gendered expectations, and institutional hurdles that women encounter in higher education [11,21].

4.1.2. Age

Most of the respondents (52%) are between the ages of 40-49 years, followed by 30-39 years (25%), 50-59 years with 21%, and 20-29 years with the least respondents of 2%. The fact that the majority of respondents fall within the 40-49 age range suggests that most people in Ghana tend to pursue a PhD in their middle age. Mid-career professionals are the most likely to pursue a PhD, as evidenced by the finding that the majority of respondents are between the ages of 40 and 49. This could be because people at this age often have professional experience, making them well positioned to pursue research that builds their practical knowledge, as evidenced by Keeley & House [8]. In line with Golde & Dore [10], people at this age may be financially more stable to meet the financial demands of a PhD program. This is consistent with studies on the demographics of PhD candidates, which frequently show that these candidates are older, particularly in non-traditional or part-time programs [22]. Studies on adult learners and professional motivation support the hypothesis that the 40–49 age group's prevalence represents a stage of life when people aim to progress in their careers or transition to academic roles [23].

Table 1. Background Characteristics of Respondents

Variables	Characteristics	N	%
Gender	Female	32	32.0
	Male	68	68.0
Age	20-29	2	2.0
	30-39	25	25.0
	40-49	52	52.0
	50-59	21	21.0
Motivation to do PhD	Acquiring knowledge to impact others	4	4.0
	Fulfillment of life dreams	2	2.0
	Job requirement	71	71.0
	Personal development	1	1.0
	Promotion	16	16.0
	Salary increment	3	3.0
	The respect that comes with the title	2	2.0
	Upgrade my knowledge	3	3.0
Occupation	Account Clerk	1	1.0
	Auditing	2	2.0
	Banker	1	1.0
	Chartered Accountant & Theologian	1	1.0
	Consultant	2	2.0
	Development consultant	1	1.0
	Finance Office	2	2.0
	Lecturer/Teacher	79	79
	Medical consultant	1	1.0
	Public servant	1	1.0
	Public Servant	2	2.0
	Research Assistant	2	2.0
	Self employed	2	2.0
	Student	1	1.0

4.1.3. Motivation to Pursue PhD

Obtaining a PhD is driven primarily by job requirements (71%), with promotion coming in second (16%) (see Table 1). Other reasons, such as “upgrade of knowledge,” “fulfilment of life dreams,” and “respect that comes with the title,” are much fewer. The data emphasises the importance of a PhD in meeting job market demands and career growth by showing that professional advancement is the main factor driving PhD

enrollment. Less frequent incentives, like respect and personal growth, point to a variety of less common causes. The results show clearly how important doctorates are for career advancement and job promotion, and this is consistent with Gopaul [2] and Leonard [1], who attested that professional and financial incentives serve as the main drivers of PhD enrolment, especially in sectors where a doctorate is required for higher-level positions.

4.1.4. Occupation

Among those surveyed, 79% are lecturers or teachers, making up the majority. Academic institutions place a premium on PhDs, as evidenced by the data. While the different remaining professions each makes up just a small percentage, ranging between 1-2%. However, the diversity of different professions demonstrates the range of professional domains in which doctorate degrees are sought. This result is in line with previous research, which indicates that academia is still the main industry for PhD holders, where the degree is frequently required for tenure-track jobs [10]. Despite their lower percentages, the variety of different occupations represented shows how increasingly non-academic careers are realising the benefits of a doctorate, a development Austin and McDaniels [24] had identified.

4.2. Challenges Encountered in Pursuit of a PhD

The challenges encountered when pursuing a PhD have been outlined in Table 2. This table, which is a two-way table, looks at the challenges against the measurement level. The data came from a Likert scale question that assessed how significant a given question was in relation to the challenges.

Table 2. Challenges encounter Pursuing PhD

Challenges	Measurement Level (%)				
	Strongly Agree	Agree	Neutral	Strongly Disagree	Disagree
Financial Constraints	32	38	18	2	10
Lack of supervisor-student rapport	49	33	10	1	7
Poor academic and research environment	22	34	27	9	8
Personal/ Family issues	31	32	24	4	9
Ill-Health	41	26	18	5	10
Lack of personal commitment	41	36	11	5	7
Lack of supervisor commitment	47	34	11	2	6
Challenges with data acquisition	22	34	27	9	8

4.2.1. Financial Constraints

On a scale of agreement to disagreement with the component, respondents were asked to rate their level of satisfaction with the challenges they encountered or are encountering pursuing their terminal degree. Their responses are as indicated in Table 2. With regards to financial constraints, 70% of respondents are in agreement that it was a major challenge they face pursuing their PhD, while 12% are in disagreement, and 18% were neutral in their response. The finding that 70% of participants agree that financial limitations pose a significant obstacle is consistent with a wealth of literature that emphasises financial struggles as something that a significant number of PhD candidates endure. The cost of pursuing a doctorate can be particularly high due to living expenditures, research expenses, and tuition fees, all of which can be made worse by the dearth of funding options [10]. Stress related to money is a well-known obstacle to finishing school and can cause students to relapse or perhaps take longer to finish [22]. The high degree of agreement among respondents raises the possibility that PhD students' financial support networks are insufficient. This is consistent with the findings of Stubb, Pyhältö, and Lonka [24], which discovered that financial strain is a major cause of stress for prospective PhD candidates.

4.2.2. Lack of Supervisor-Student Rapport

On lack of supervisor-student rapport, 82% agreed that it was a challenge to them, 10% were neutral, and 8% were in disagreement. The fact that 82% of respondents think that a problem occurs when there is not a good rapport between the supervisor and the student illustrates how important these relationships are to doctorate students' performance. As a cornerstone of doctorate education, effective supervision is widely acknowledged to influence both academic success and student well-being [25]. Misaligned expectations, inadequate communication, and a lack of support between supervisors and students can cause serious problems, such as low motivation and feelings of loneliness [26]. According to research, timely completion of PhD programs and greater satisfaction are linked to supervisors that provide good and encouraging relationships [27].

4.2.3. Poor Academic and Research Environment

The results show that 56% agreed that the environment for research and academia was a challenge. Studies that emphasize the significance of a supportive academic environment for PhD performance are consistent with the conclusion that 56% of respondents agreed that problems exist in the research environment and academia. Inadequate funding, a lack of access to essential data, and an unwelcoming academic atmosphere can all be obstacles in the research environment [28]. The comparatively large number of neutral replies (27%) implies that people's opinions about the study environment might differ greatly based on their personal experiences as well as the institutional settings in which they are situated. Pyhältö et al. [24] assert that a doctorate student's sense of academic engagement and belonging is greatly influenced by their research environment.

4.2.4. Personal/ Family Issues

The majority of respondents (63%) consider personal or family issues to be significant challenges. However, significantly more respondents (24%) are neutral, and comparatively fewer people disagree (8%) or strongly disagree (9%). It is therefore estimated that about two-

thirds of the respondents agree to personal or family issues interfering with the progress of the PhD quest, while almost one quarter of the respondents are not sure whether personal or family issues affect their PhD progress, with 13% certain of it not affecting the PhD journey. It is therefore evident from the results that PhD students frequently struggle to strike a balance between their academic obligations and their personal and familial commitments, especially if they are older or have caregiving duties, and this is in line with Kasworm, 2010. Research highlighting the value of work-life balance in preserving mental health and averting burnout in PhD candidates supports this conclusion as well [29].

4.2.5. Ill-Health

A total of 67% of respondents are in agreement that ill health is a challenge. Of the responses, 18% were neutral, 5% strongly disagree, and 10% disagree. The fact that 67% of respondents said that being unwell is a challenge highlights the potential problems with both physical and mental health that might develop while pursuing a doctorate. Stress, long hours, and isolation that come with earning a PhD have been connected to a number of health issues, such as physical disease, anxiety, and depression [30]. According to the literature, PhD students are more likely than the general population to develop mental health problems, in part because doctoral programs are quite demanding [31].

4.2.6. Lack of Personal Commitment

A significant majority of respondents (77%) either strongly agree (41%) or agree (36%) that a lack of personal commitment is a challenge. Relatively not many respondents disagree (7%) or strongly disagree (5%), or are indifferent (11%). The fact that 77% of the respondents agreed that their lack of personal dedication poses a difficulty underscores the inherent drive needed to finish a doctorate. When embarking on the extensive and often solitary journey of doctoral research, persistence and self-control are essential [10]. Numerous elements, such as an innate interest in the study topic, well-defined goals, and the supportive nature of the academic environment, have been found to have an impact on personal commitment [22]. The very low percentage of disagreement indicates that most respondents understand how critical it is to continue putting in a lot of effort on a personal level in order to succeed in their doctoral studies.

4.2.7. Lack of Supervisor Commitment

A lack of supervisory commitment has been identified by 81% of respondents, 47% of whom strongly agree and 34% of whom agree. 11% of the respondents are neutral, 2% strongly disagree, and 6% disagree. The fact that 81% of respondents said that they had difficulty with a supervisor's lack of commitment highlights how important supportive and involved supervision is to PhD education. Disengaged or busy supervisors can postpone feedback, provide inadequate guidance, and eventually result in lower student satisfaction and achievement [25]. The high degree of agreement suggests that there is a general concern about supervisor commitment, which is corroborated by research showing the detrimental effects of insufficient supervision on PhD completion rates [28].

4.2.8. Challenges with Data Acquisition

56% acknowledged that there are challenges with obtaining data (22% strongly agree and 34% agree). Relatively few respondents disagree (8%), and even fewer strongly disagree (9%) or are neutral (27%). Obtaining data is a common issue in doctoral research, as indicated by 56% of respondents. Institutional obstacles, moral dilemmas, and practical challenges are a few of the things that might make data access difficult [32]. According to the literature, problems gathering data can cause major delays in the advancement of the research project and add to the general stress that doctorate students face [28]. The comparatively high number of neutral replies (27%) can be a sign of variations in the availability of data for various projects and disciplines of study.

4.3. Factors that play a significant role in addressing the challenges of study delay

Table 3 classifies responses from respondents into three measurement levels: Agree, Neutral, and Disagree, and lists factors that play a significant role in addressing challenges faced by those who pursue PhD.

Table 3. Factors that play a significant role in addressing the challenges of study delay

Factors	Measurement Level (%)		
	Agree	Neutral	Disagree
Good academic and research environment	97	3	0
Personal attitude	96	3	1
Good financial support	95	5	0
Availability of resources	99	1	0
Good researchable topic	94	4	2
Good communication skills	81	16	3
Good writing skills	90	10	0
Time management skills	96	4	0
Area of expertise	96	4	0
Supervisor support	94	6	0
Peer support	85	14	1
Study location	72	19	9

It can be seen from the table that an overwhelming majority of respondents agree to all the factors listed. Good academic environment (97%), personal attitude (96%), financial support (95%), resources (99%), time management skills (96%), and area of expertise (96%) are almost universally agreed upon, Good researchable topic (94%), supervisor support (94%), and writing skills (90%) are highly agreed upon but with a few neutral responses, Communication skills (81%), peer support (85%), and study location (72%).

5. Further Analysis

Structural Equation Modeling was adopted to examine the relationship between PhD acquisition, challenging factors, and remedial factors.

5.1. Structural Equation Modeling

Figure 1 depicts the confirmatory factor analysis of all of the variables to be considered in the structural equation model (SEM).

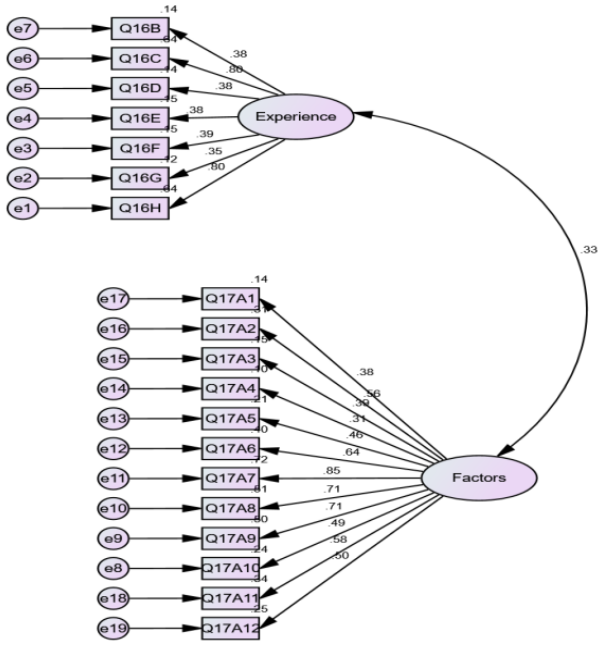

Figure 1. Confirmatory Factor Analysis

First, the variables were evaluated for the significance of their weight in the SEM. Scholars have several guidelines for determining the relevance of the standardised factor loading size. For example, whereas Hair et al. [18] highlighted a minimum size of 0.5 as a standardised factor loading to be considered significant, Stevens [33] advocated for more than 0.4. According to Cheung et al. [34], many researchers have adopted the Fornell and Larcker (1981) criterion of "average variance extracted value greater than 0.5" for evaluating convergent validity in addition to looking at standardised factor loadings, where latent variables explain at least half of the variations in the indicators that are linked to it [35,36].

In the context of our study, we adhere to the standard proposed by the aforementioned experts and use a rule of thumb to discriminate between variables: those with 0.55 (55%) are deemed major contributors, while those with less than that are considered insignificant. As a result, only two of the seven variables that assess factors that may hamper students' completion of a PhD program in time were significant enough to be included in the SEM. These characteristics are poor academic or research environments and data collection difficulties, each contributing 0.8 (80%). Six of the twelve variables used to measure the factors that significantly expedite completing a PhD program in Ghana in time, namely personal attitude, good communication skills, good writing skills, time management skills, area of expertise, and supervisory support, were significant enough to be included in the SEM.

Figure 2 depicts the structural equation model (SEM), which reflects the link among factors experienced by PhD students and PhD completion, which are latent variables, and the measurement model that links each measurement variable to its corresponding latent variable.

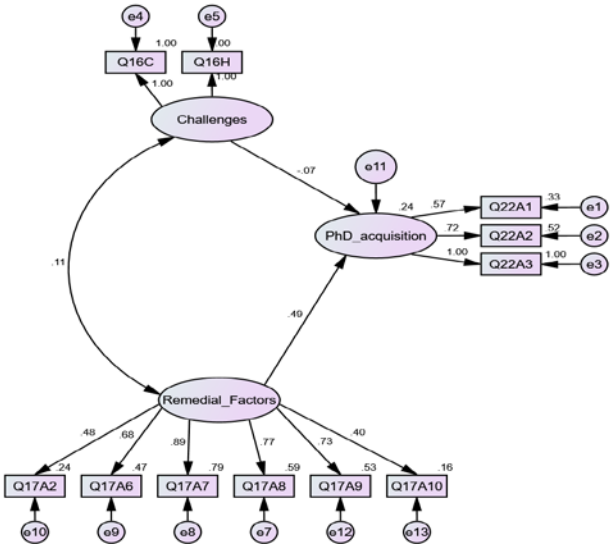

Figure 2. Structural Equation Model

As shown in Figure 2, the remedial factors positively affect the acquisition of a PhD by 0.49 (49%), implying that these factors drive PhD candidates to complete their programs within the specified period of time. On the other side, challenging factors have a negative effect on PhD acquisition by -0.07 (7%). This means that these obstacles compel students to extend their PhD studies beyond the regular time frame, causing a student's PhD acquisition to be delayed beyond the ordinary length of time of study. The challenges and remedial factors had a backward-and-forward relationship, with a covariance of 0.11 (11%) between the variables, (See Figure 2).

Furthermore, from the SEM, six important variables have been identified as the impacting factors that help a student complete his or her PhD degree in Ghana in time. The factors and their percentages of influence are as follows: Personal attitude: 0.48 (48%); good communication skills: 0.68 (68%); good writing skills: 0.89 (89%); time management skills: 0.77 (77%); area of expertise: 0.73 (73%); supervisory support: 0.40 (40%).

Additionally, two factors were used to examine the circumstances that may lead to a student's delay in completing his or her PhD program and obtaining a PhD degree in Ghana. These are poor academic or research environment and data collection issues, with corresponding rates of 1.00 (100%) and 1.00 (100%), respectively.

Table 4 displays that factors that impede and expedite the completion of a PhD, as experienced by PhD students. These factors have a substantial impact on the acquisition of a PhD in Ghana ($p < 0.012$ and $p < 0.044$, respectively). It is important to highlight that several of the measurement variables have a considerable influence on their respective latent variables. Previous research that has examined challenges in doctorate education is consistent with the factors found in this study that are obstacles to completing a PhD. Lovitts [28] and Golde [10], for instance, stress that serious challenges to PhD progress for students can include inadequate supervision, an absence of institutional support, and financial limitations. Given that these obstacles are statistically significant ($p < 0.012$) in the Ghanaian context, it is likely that resource constraints and systemic problems in Ghana's higher education system are to blame for how severe these difficulties are. Additionally,

Pyhältö et al. [24] draw attention to the psychological pressures and feelings of inadequacy and loneliness that are connected to doctoral studies and might make PhD students' struggles worse. These pressures may cause attrition or a longer time to finish the program. Given how much these obstacles affect Ghanaian PhD candidates, it is imperative that these issues be resolved if doctorate education results are to be improved in the area.

Table 4. Path Weights for Latent and Indicator Variables

Path			Estimate	S.E.	C.R.	P-value
PhD Acquisition	<---	Challenges	-0.068	0.411	5.870	0.012
PhD Acquisition	<---	Remedial Factors	0.495	0.212	4.11	0.044
Q22A1	<---	PhD Acquisition	0.575	0.501	7.230	0.022
Q22A2	<---	PhD Acquisition	0.720	0.314	4.020	0.078
Q22A3	<---	PhD Acquisition	0.998	0.533	9.104	0.056
Q16C	<---	Challenges	1.000	0.332	3.814	0.001
Q16H	<---	Challenges	1.000	0.512	8.657	0.004
Q17A8	<---	Remedial Factors	0.766	0.188	2.654	0.034
Q17A7	<---	Remedial Factors	0.890	0.270	4.890	0.005
Q17A6	<---	Remedial Factors	0.684	0.521	6.020	0.062
Q17A2	<---	Remedial Factors	0.485	0.330	4.611	0.010
Q17A9	<---	Remedial Factors	0.729	0.162	2.713	0.000
Q17A10	<---	Remedial Factors	0.395	0.219	4.007	0.059

The p-value of less than 0.044, on the other hand, indicates that the factors that accelerate PhD completion are equally significant. These factors likely include strong social support networks, adequate supervision, and access to research resources, all of which have been identified in prior studies as critical facilitators of doctoral success [22] (Bair & Haworth, 2005). The positive impact of these facilitators suggests that PhD students in Ghana who receive adequate support are more likely to complete their programs on time. Gardner [22], for example, talks about how important it is to integrate PhD students into academic communities so they can get peer support and mentorship. Their academic growth is further enhanced by this socialization process, which also offers emotional and psychological support, a necessary skill for overcoming the obstacles of PhD research. The potential advantages of creating encouraging learning environments within educational institutions that might assist students in overcoming challenges and accelerating their progress are shown by the statistical relevance of these enabling characteristics in Ghana.

5.1.1. Model Diagnostics

The goodness-of-fit metrics is presented in Table 5. In this table a comparison is made between the simplified model and the independence model rather than comparing it to the saturated model. The Normed-Fit index (NFI) measure has a score of 0.948 (94.8%), which is above the recommended cutoff value of 0.90 (90%) by Bentler and Bonnet (1980). As a result, we concluded that our study model indicates a good fit.

Table 6 also displays the best fit measure, which uses the Root Mean Square Error of Approximation (RMSEA) value to determine whether there is a lack of best fit for our model when comparing the reduced and saturated models. The recorded measure for our RMSEA value was 0.016, and this falls between 0.011 and 0.019, making it significantly lower than the necessary threshold of 0.05. This means that our model demonstrates adequate fitness for our study.

Table 5. Baseline Comparison

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	0.948	0.930	0.910	0.905	0.057
Independent model	1.000	1.000	1.000	1.000	0.000

Table 6. RMSEA

Model	RMSEA	LO90	HI90	P-value
Default model	0.016	0.011	0.019	0.073
Independent model	0.048	0.041	0.052	0.000

6. Conclusion and recommendation

The study identifies a number of critical elements that impact Ghanaian students' decision to pursue a PhD, highlighting both the benefits and challenges encountered along the way. We conclude that the main purpose for getting a PhD is to enhance their careers, specifically to fulfill job requirements. This underlines the vital role a PhD plays in Ghanaian academic and industry career advancement. Nevertheless, obtaining this final degree is a difficult path that comes with many obstacles, such as limited funds, poor supervisor-student communication, and personal or family problems.

In order to show how these components interact to affect the PhD journey, Structural Equation Modeling (SEM) was used to uncover the intricate relationships between difficulty factors, remedial factors, and PhD attainment. Again, it was concluded that a lack of commitment from supervisors, personal problems, and financial limitations were found to be major barriers, according to the investigation. These difficulties impair PhD students' mental and physical health in addition to impeding their academic progress with majority of respondents citing poor health as a serious concern.

The study also discovered that although remedial elements like a positive outlook, effective communication, and supervisory assistance are vital in reducing these difficulties, the quality of the academic and research environment has a major impact on PhD students' achievement. In conclusion, a resource-rich and encouraging environment is necessary for PhD programs to be completed on time.

For the benefit of PhD students in overcoming the challenges of academic research, the study recommends the following:

1. Ghanaian research institutions and universities should expand financing, offer more extensive research resources, and set up support networks.

This entails having access to current research databases, libraries, and technology tools.

2. Universities provide well-organized mentorship programs in which seasoned academics assist PhD candidates with their research. The main objective of this mentorship should be to help the student grow both academically and personally so that they can overcome the challenges of their PhD studies.
3. Universities provide mental health and counseling services appropriate for PhD students' need so as to lessen the psychological strain that is frequently connected to PhD study. This program should emphasize stress management, work-life balance, and resilience-building techniques.

Data Availability Statement

The datasets are available from the corresponding author upon reasonable request.

Ethics Statement

All methods were performed in accordance with the Kumasi Technical University (KsTU) ethics and guidelines. This was approved by KsTU Research Ethics Committee. KsTU Research Ethics Committee does not provide approval number.

Author Contributions

Mary Ann Yeboah: conceived of idea; literature review; design of data collection instrument; investigation and cleaning of data; writing original draft. Ama Pokuah Obeng: design of data collection instrument; collected the data; writing—review and editing. Kwame Annin, Francis Yaw Anyan: methodology or analysis tools; Performed the analysis; writing—formal analysis. Rosemary Abayase, Elizabeth Serwaa Koomson: literature review; design of data collection instrument; writing, review, and editing.

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References

[1] Leonard, D. (2001). A woman's guide to doctoral studies. McGraw-Hill Education (UK).

[2] Gopaul, B. (2011). Distinction in doctoral education: Using Bourdieu's tools to assess the socialization of doctoral students. Equity & Excellence in Education, 44(1), 10-21.

[3] Urquhart, A., & Zhang, H. (2021). PhD CEOs and firm performance. European Financial Management, 28(2), 433–481.

[4] Thompson, G. & Anderson, C. (2022). The pursuit of doctoral degrees: Personal fulfillment and intellectual challenge. Studies in Graduate and Postdoctoral Education, 13 (4), 320-336.

[5] Hancock, C. N., & Roush, J. R. (2023). Doctoral degrees as gateways to academic careers: Motivations and aspirations. Higher Education Quarterly, 77(1). 58-74.

[6] Mensah, P. K. (2019). Exploring the impact of doctoral education on local knowledge and development: A Ghanaian perspective. Ghana Social Science Journal, 16(1), 45-62.

[7] Owusu-Ansah, J. & Gyamfi, A. (2020). PhD research in Ghana: Contributions to policy and societal development. African Educational Research Journal, 8(2), 123-135.

[8] Keeley, B., & House, A. (2013). The role of higher education in promoting social mobility: A comparative analysis. Higher Education Policy, 26(2), 201-220.

[9] Baker, V. L., & Lattuca, L. R. (2010). Developmental networks and learning: Toward an interdisciplinary perspective on identity development during doctoral study. Studies in Higher Education, 35 (7), 807-827.

[10] Golde, C. M., & Dore, T. M. (2001). At Cross Purposes: What the experiences of doctoral students reveal about doctoral education. The Pew Charitable Trusts.

[11] Ceci, S. J., & Williams, W. M. (2011). Understanding current causes of women's underrepresentation in science. Proceedings of the National Academy of Sciences, 108(8), 3157-3162.

[12] Cech, E. A., & Blair-Loy, M. (2019). The Changing Career Trajectories of New Parents in STEM. Proceedings of the National Academy of Sciences, 116(10), 4182-4187.

[13] Elsevier. (2020). The researcher journey through a gender lens: An examination of research participation, career progression and perceptions across the globe. Elsevier. https:// www.elsevier.com/ research-intelligence/resource-library/gender-report-2020.

[14] Ampofo A. A., & Boateng, J. (2019). Gender and academic leadership in Ghana: A critical reflection. Africa Sociology Review, 23(1), 50-69.

[15] Atkinson, C., Briner, R. B., & Litchfield, P. (2022). The impact of doctoral study on mental health and wellbeing: A systematic review, Higher Education Research & Development, 41(4), 757-773.

[16] Bluntz, C. (2020). The emerging focus on mental health in doctoral education: A critical review. Journal of Graduate Education, 42(2), 123-140.

[17] Barry, K. M., Woods, M., Warnecke, E., Stirling, C., & Martin, A. (2018). Psychological health of doctoral candidates, study-related challenges and perceived performance. Higher Education Research & Development, 37(3), 468-483.

[18] Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2009). Multivariate data analysis (7th ed.). Prentice-Hall.

[19] Cole, D. A., & Preacher, K. J. (2014). Manifest variable path analysis: Potentially serious and misleading consequences due to uncorrected, measurement error. Psychological Methods, 19(2), 300-315.

[20] National Science Foundation. (2023). Women, minorities, and persons with disabilities in science and engineering: 2023. National Centre for Science and Engineering Statistics (NCSES). https://ncses,nsf,gov/pubs/nfs23300/.

[21] UNESCO. (2020). Global Education Monitoring Report 2020: Inclusion and education: All means all. UNESCO Publishing.

[22] Gardner, S. K. (2009). Student and faculty attributions of attrition in high and low-completing doctoral programs in the United States. Higher Education, 58(1), 97-112.

[23] Kasworm, C. E. (2010). Adult learners in a research university: Negotiating undergraduate student identity. Adult Education Quarterly, 60(2), 143-160.

[24] Austin, A. E., & McDaniels, M. (2006). Preparing the professoriate of the future: Graduate student socialization for faculty roles. Higher Education: Handbook of Theory and Research, 21, 397-456.

[25] Pyhältö, K., Stubb, J., & Lonka, K. (2009). Developing scholarly communities as learning environments for doctoral students. International Journal for Academic Development, 14(3), 221-232.

[26] Lee, A. (2008). How are doctoral students supervised? Concepts of doctoral research supervision. Studies in Higher Education, 33(3), 267-281.

[27] Halse, C., & Malfroy, J. (2010). Retheorizing doctoral supervision as professional work. Studies in Higher Education, 35(1), 79-92.

[28] Pearson, M., & Brew, A. (2002). Research training and

supervision development. Studies in Higher Education, 27(2), 135-150.

[29] Lovitts, B. E. (2001). Leaving the ivory tower: The causes and consequences of departure from doctoral study. Rowman & Littlefield Publishers.

[30] Stubb, J., Pyhältö, K., & Lonka, K. (2011). Balancing between inspiration and exhaustion: PhD students' experienced socio-psychological well-being. Studies in Continuing Education, 33(1), 33-50.

[31] Levecque, K., Anseel, F., De Beuckelaer, A., Van der Heyden, J., & Gisle, L. (2017). Work organization and mental health problems in PhD students. Research Policy, 46(4), 868-879.

[32] Evans, T. M., Bira, L., Gastelum, J. B., Weiss, L. T., & Vanderford, N. L. (2018). Evidence for a mental health crisis in graduate education. Nature Biotechnology, 36(3), 282-284.

[33] Mullins, G., & Kiley, M. (2002). 'It's a PhD, not a Nobel Prize': How experienced examiners assess research theses. Studies in Higher Education, 27(4), 369-386.

[34] Stevens, J. P. (2002). Applied multivariate statistics for the social sciences (4th ed.). Erlbaum.

[35] Cheung, G.W., Cooper-Thomas, H.D., Lau, R.S., Wang, L.C. (2024). Reporting reliability, convergent and discriminant validity with structural equation modeling: A review and best-practice recommendations. Asia Pacific Journal of Management 41, 745–783.

[36] Yu, M., Lin, H., Wang, G. G., Liu, Y., & Zheng, X. (2021). Is too much as bad as too little? The S-curve relationship between corporate philanthropy and employee performance. Asia Pacific Journal of Management.