Integrated Science Entry Grades Connection with End-of-Course Completion Grades in Science in a College of Education in Ghana

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Abstract
Previous experience is essential in the teaching and learning process because it serves as a basis for learners in tackling subsequent problems. It is on the basis of this, the researchers took up this study to explore the relationship between the entry grades of pre-service teachers in integrated science and their end-of-course completion grades in science-related courses at the college level. The quantitative descriptive survey research design was employed in this study. A sample of 124 pre-service teachers was purposively selected for the study with a checklist as the data collection instrument. Frequencies, percentages, and Spearman's rho were used to analyse the data collected. The study discovered a noteworthy result regarding the relationship between entry grades and academic performance in science-related courses. The findings revealed a weak positive correlation between pre-service teachers' integrated science entry grades from the West African Senior School Certificate Examination and their subsequent performance in general biology, chemistry, and physics at the college level. It emphasised the limited effectiveness of relying only on entry grades as a criterion for college admissions. Based on the findings, it was recommended that policymakers and colleges of education move beyond the singular reliance on entry grades in admissions and consider a more comprehensive approach incorporating a broader range of factors that influence academic performance.
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1. Introduction

Colleges of Education (CoE) in Ghana, which are now degree awarding institutions and other higher educational institutions (HEI), strive to be centres of excellence in knowledge and skills generation among students. In view of this, conditions and factors leading to better students' academic performance prior to and after admission into these institutions become crucial. Almost all HEIs admit students based on their entry grades with the intention of admitting the most qualified ones (Geiser & Santelices, 2007). Since learning is a cumulative process, a student admitted with higher entry grades is expected to be better prepared for the course content than one admitted with lower grades (Wambugu & Emeke, 2013).

Several researchers have looked into the relationship between entry grades and the academic performance of students in different courses in HEIs. The results of these investigations, on the other hand, have never been decisive because the researchers have always reported a variety of, and often contradictory, findings. For example, previous studies have revealed a strong (Ogbonnaya et al., 2014; Osei & Adu-Poku, 2020), low (Agbo, 2003; Edokpayi & Suleiman, 2011), mixed (Ugwu, 2011; Wambugu & Emeke, 2013) relationship between students' entry grades in science related courses and their grades and performance at various levels of education. For instance, Ogbonnaya et al., (2014) investigated the association between university students' entry grades in science and academic achievement and discovered a substantial positive relationship between the two scores. Osei and Adu-Poku (2020) buttress this in a study on pre-service mathematics and science teachers' entry grades in mathematics and their performance in algebra II and found that their entry grades in core and elective mathematics as obtained at the senior high reflect their performance in the first year, first semester examination in Algebra II. Lawal et al., (2020) further confirmed that there exists a positive association between students' entry grades in integrated science and their subsequent performance in the same subject at the college level. Despite the aforementioned research supporting the notion that entry grades in integrated science can predict performance in science-related courses, other studies have discovered a weak relationship between entry grades and academic achievement. Agbo (2003) conducted a study focusing on various science subjects at the university level and identified a low correlation between entry grades and students' performance. Similarly, Edokpayi and Suleiman (2011) reported that the grades attained by students in integrated science during the Junior Secondary School Certificate (JSC) examinations, specifically among selected secondary schools in Zaria metropolis, poorly predicted the students' later performance in chemistry during the Senior Secondary School Certificate (SCE) examination.

Some studies have reported mixed findings. For instance, in a study conducted in Nigeria, Ugwu (2011) found that students' scores/grades in Pre-Nigeria Certificate in Education (Pre-NCE) chemistry, physics, and biology related positively, albeit low, correlation with their grades in Nigeria Certificate in Education (NCE) Integrated

Science. This observation was supported by Wambugu & Emeke (2013), who conducted a study on the relationship between entry grades and academic performance in undergraduate science courses in Kenya. Their research indicated a significant positive correlation between entry grades and academic performance in chemistry and biology. However, in physics there was almost no linear relationship between entry qualification and academic performance. Additionally, the results demonstrated that entry grades accounted for less than 50.0% of the variation, indicating that entry grade alone was not the best predictor of academic performance.

Although many countries have consistently utilised previous entry grades as admission criteria for admitting students into tertiary institutions, its use as the primary factor for undergraduate admission has faced criticism for various reasons. The effectiveness of entry grades in informing student academic performance at the tertiary level is not universally acknowledged (Danilowicz-Gösele et al., 2017). Not everyone believes that a student's good previous entry grade will necessarily translate into improved academic performance at the tertiary level. Moreover, in addition to pre-tertiary grades, several experts have identified numerous other factors that influence students' academic performance in tertiary institutions. Nevertheless, according to Richardson et al., (2012), the use of previous grades still stands out as a significant factor that informs students' academic ability in higher education institutions.

Overall, a review of the relevant literature (Agbo, 2003; Ogbonnaya et al., 2014; Ugwu, 2011) does not show a consensus on whether entry grades (pre-tertiary grades) effectively informs students' academic performance at the tertiary level. Evidence supporting this notion appears to be scanty in the literature pertaining to Ghana, underscoring the need for further research in this area. Currently, the practice in Ghana involves admitting pre-service teachers based on their past (pre-tertiary) grades. However, there are still gaps in establishing a connection between these entry grades of pre-service teachers and their academic performance in college, hence the need for this kind of study.

The few studies conducted in Ghana on pre-tertiary entry grades and academic performance have focused on courses including Accounting (Aidoo-Buameh & Ayagre, 2013), African Studies, Communicative Skills and Computer Literacy (Afua, 2021), mathematics (Osei & Adu-Poku, 2020) at the tertiary level have also revealed similar results as discussed. Other studies have also focused on factors such as hours of study, personal study schedules, etc. (Issahaku, 2017) and entry and exit grades [aggregates and cumulative grade point average (CGPA)] (Anane, 2018); Doe et al., 2018; Gyampoh, 2020; Kwapong, 2018). From the foregoing review of literature, there appears to be inadequate information on students' entry grades in only integrated science and their performance in science-related courses in HEIs in Ghana. This means that there is a need to conduct further research into this area in Ghana. Also, the researcher's observation over the years of students who do science-related courses (SRCs) [biology, chemistry, and physics] at the college where he is a lecturer revealed that the performance of most of the students in science-related courses differed from their entry grades in integrated science. That is, some students who did not do well in integrated science end up doing well in SRCs, whereas others who did well in integrated science do not perform well in SRCs. This current study therefore examined the relationship between pre-service teachers' integrated entry grades and their end-of-course completion grades in SRCs at college.

2. Research Objective
1. Explore the relationship between the pre-service teachers' entry grades in integrated science and their end-of-course completion grades in general biology, chemistry, and physics.

3. Methodology
The quantitative descriptive survey research design was employed in this study. The target population for this study was the 2018/2019 batch of the Bachelor of Education Primary Education programme since they offered science-related courses at the college. Their total number was one hundred and fifty-four (154), comprising eighty-six (86) males and sixty-eight (68) females. One hundred and twenty-four (124), consisting of seventy (70) males and fifty-four (54) females of these students were purposively selected for the study. Prior to the data collection, participants consent was sought. They were made to sign a consent form to register their volition in the inclusion of the study. Identity numbers (IDs) generated by the researchers were used in place of the names of the participants, and the data were kept in a way that no third party got access to it. These were done to ensure the anonymity and confidentiality of the participants, the grades and scores they obtained.

The researchers officially wrote to the Principal of the College to request the results slips and statement of results of the sampled students. The results slips and statement of results were supplied by the academic affairs unit of the college. A 4- item checklist was then used to extract only the sex, date of birth, grades obtained in integrated science from WASSCE, general biology, chemistry and physics from college by the selected students. In order to establish the validity and reliability of the documents (results) used in this study, the test items or the examination questions that yielded the documents (results) the researchers used for this study went through a rigorous validation process by West African Examination Council (WAEC) and Institute of Education, University of Cape Coast (IoE-UCC), which are the accredited institutions that conducted those examinations. The results

(documents) of the students, once released by these examination bodies, do not change and are always available for reference. The research can therefore be repeated at any time with the same documents.

The extracted data were sorted, coded and analysed using the Statistical Package for the Social Sciences (SPSS) software version 26. The data was analysed into frequencies, percentages, Spearman's rho at a 0.05 level of significance.

4. Results and Discussion

The sex distribution of students, showed that 70 (56%) of the participants were males, while the remaining 54 (44%) were females. This means the males outnumbered the females by 12% indicating that gender disparity still existed in the 2018/2019 batch of the Primary Education pre-service teachers who were admitted to the College. Also, the age range of participants (pre-service teachers) out of the one hundred and twenty-four (124) pre-service teachers used for the study, 70 (56.5%) were aged between 21 and 25 years; 46 (37.0%) between 26 and 30 years. The remaining 8 (6.5%) were 31 years and above. This result shows that the majority of the pre-service teachers were aged between 21 and 25 years. Also, it could be said that 93% of pre-service teachers were aged between 21 and 30 years, while 26% were aged 26 and above. These results indicate that most of the pre-service teachers were young adults. This is the stage where students are energetic and eager to learn, which could influence their academic performance.

Table 1. The Spearman Rank Order Correlation Coefficient on integrated science scores and general biology, chemistry, physics scores. (N=124)

	Sig.(2-tailed)	Spearman's rho	Coefficient of determination (rho)
Relationship between integrated science scores and general biology scores	0.028	0.197	0.039
Relationship between integrated science scores and general chemistry scores	0.016	0.215	0.046
Relationship between integrated science scores and general physics scores	0.013	0.223	0.050

$p<0.05$

Source: Siemoh et al. (2022) field data

The relationship between pre-service teachers integrated science grades/scores (obtained from WASSCE) and general biology grades/scores (measured using pre-service teachers general biology scores at college) was examined using Spearman's rho (Table 1). Preliminary analyses were performed to ensure no violation of the assumptions of normality, linearity, and homoscedasticity. This analysis revealed the Komogorov-Smirnov statistic for general biology (Sig.=0.020), chemistry (Sig.=0.000) and physics (Sig.=0.001) as significant (Sig. values less than 0.05), suggesting a violation of the assumption of normality. The Spearman Rank Order Correlation (rho) became the obvious non-parametric alternative for any further analysis. There was a weak, positive correlation between integrated science and general biology [rho = 0.197, n = 124, p<0.05], integrated science and general chemistry [rho = 0.215, n = 124, p<0.05] and integrated science and general physics [rho = 0.223, n = 124, p<0.05]. The researchers have defined the Spearman's rho score of 0.197, 0.215 and 0.223 to be an estimate of a weak correlation using Pallant (2016) category of strong (0.5 to 1.0), medium (0.3 to 0.49), and weak (0.10 to 0.29).

In all cases, the study found a weak positive correlation between pre-service teachers integrated science grades from WASSCE and general biology, chemistry, and physics grades at the college. This means that high scores in integrated science from WASSCE is associated with relatively high scores in general biology, chemistry, and physics scores at the college. The weak association is also an indication that the academic environments at the various senior high schools the pre-service teachers attended may have differed, but at the college the environment was equalised, so their performance now depended on their own efforts, motivation, the college environment, and college tutor factors. This finding is in agreement with previous studies which found a low relationship between entry grades and academic performance. For instance, Agbo (2003) conducted a study on different science subjects at university level and identified a low correlation between entry grades and students' performance.

In a nutshell, the study revealed a noteworthy finding regarding the relationship between entry grades and academic performance in science-related courses. It shed light on the limited effectiveness of relying only on entry grades as a criterion for college admissions. But rather the need for policymakers to move beyond the singular reliance on entry grades in admissions and consider a more comprehensive approach incorporating a broader range of factors that influence academic performance.

5. Conclusion

This study supports the idea that there is a weak/low relationship between entry grades and the academic performance of students in HEIs. This was confirmed when it was found that there was a weak but positive correlation between the pre-service teachers' integrated science scores from WASSCE and general biology, chemistry, and physics scores at the college level.

6. Practical implication

The practical implication of this study is that relying solely on entry grades as a criterion for college admissions in science-related courses may not be the most effective approach. The findings suggest that entry grades have only a tenuous positive correlation with academic performance in these courses. As a result, policymakers should expand policy priorities and incorporate a broader range of criteria for the admission of prospective pre-service teachers into colleges of education. This will enable colleges to accurately assess candidates' potential and identify individuals who may excel in science-related courses despite having lower entry grades.

7. Limitation and future research

This quantitative study was limited to 2018/2019 batch of pre-service teachers who offered Bachelor of Education Primary Education programme in only one college in the Bono East Region, Ghana and therefore generalisation is limited. As a result, this study should be replicated in other Colleges of Education for a clearer picture of the situation.

8. Declaration of conflict of interest

The authors declare no potential conflict of interest with respect to the research, authorship, and/or publication of this article.

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10. Ethics Statement

Ethical considerations were diligently followed during the data collection process. Permission was obtained from the College management and ethical approval was sought from the research project work coordination team. The researchers sent an official request to the Principal of the College, specifically asking for the results slips and statement of results of the sampled students. Prior to data collection, researchers met with the sampled students to discuss the study's purpose. They also signed consent forms, ensuring their voluntary participation. In order to protect privacy, identity numbers were used instead of names, and strict measures were implemented to secure the data, maintaining anonymity and confidentiality of the participants and their academic information. It was only the secondary data (i.e., academic grades in science) of the participants were used in this study.

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