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Research Article

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College academic performance in science-related programs and senior high school strands: A basis for higher education admission policy

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ABSTRACT

In compliance with RA 10931(the Universal Access to Quality Tertiary Education Act), the Commission on Higher Education (CHED) allows State Universities and Colleges (SUCs) in the Philippines to admit students regardless of their senior high school track and strand taken, through CMO 105, Series of 2017. This would cause future problems because the nature of these graduates' high school studies would be disregarded when evaluating applicants for a certain bachelor's degree. This study was conducted to determine if a specific Senior High School strand produces high-achieving students in science-related programs. Using a causal-comparative research design, it engaged sixty-one (61) undergraduate students enrolled in Two Philippine State Universities offer Science-related courses: Bachelor of Science in Biology, Bachelor of Science in Chemistry, and Bachelor of Science in Environmental Science. One-way ANOVA was done to find if there is a significant difference among the academic performance of the respondents grouped by their senior high school strands. Dunn's Test for Multiple Comparisons was used as post-hoc analysis. The ANOVA test showed a significant difference between academic performance in science-related programs and senior high school strands $p = 0.015$, while no significance was found in sex and annual household income. Conducting post-hoc analysis using Dunn's Test for Multiple Comparisons showed that STEM graduates have a statistically significant academic performance between ABM, GAS, HUMSS, Home Economics, and ICT graduates. The findings show significant implications in the admission of students in college, especially in science-related programs. Strands in senior high school must be considered and that short-bridging programs may be conducted for non-STEM graduates enrolled in science-related programs.

Introduction

The Philippines, being one of the last three nations in the world with a basic education curriculum of only ten years has led to the inception of the K-12 curriculum which mandates that Filipino children receive 12 years of elementary education. Formerly known as 'high school,' the four-year secondary education will now be referred to as 'junior high school,' with the same number of years. After completing junior high school, kids will attend senior high school for an additional two (2) years (Macha, Mackie, & Magaziner, 2018). The "Enhanced Basic Education Act of 2013" requires one year of kindergarten, six years of elementary school, and six years of high school. Secondary education includes four years of junior high and two years of senior high. Senior high school has four tracks: Academic, TVL, Sports, and Arts and Design. Each of these paths includes "strands," or specific fields of study. The Academic Track has four strands: General Academic, Humanities and Social Sciences, STEAM, and Accountancy, Business, and Management (ABM). The Technical Vocational Livelihood Track includes Agricultural Arts, Home Economics, and ICT (ICT). Athletics, Fitness, and Recreation are on the Sports track, whereas Visual Arts and Performing Arts are on the Arts and Design track (Cueva, 2019). These programs were developed to boost student productivity and the nation's workforce (Acosta & Acosta, 2016). K-12 curriculum changes aim to close the education gap with our neighbors (Calderon, 2014). Globalization requires us to mirror other countries' educational systems.

The Commission on Higher Education (CHED) allows SUCs to enroll students regardless of high school graduation status. This is in compliance with RA 10931, the Universal Access to Quality Tertiary Education Act, and CHED CMO 105, Series of 2017. The act would cause future problems because the nature of these graduates' high school studies would be disregarded when evaluating applicants for a certain bachelor's degree. If their senior high school classes weren't linked with their strand or track, pupils would struggle in college (Conley, Aspengren, Stout, & Veach, 2006). Students who were not enrolled in the Senior High School course that matched their strand of study gave several reasons, such as the influence of their family, the availability of the program at a nearby university, pressure from friends and peers, uncertainty about their desired career path, their family background, not meeting the required grades, and a lack of guidance regarding future career opportunities during their time in high school (Quintos, Caballes, Gapad, & Valdez , 2020).

Okabe (2013) argued that increasing secondary school time will keep the Philippines competitive with its Southeast Asian neighbors. He asserted that our outdated educational system was responsible for pedagogical and social issues. Increased years in the new Basic Education Curriculum (BEC) of the Philippines will result in various demographic profiles among potential tertiary education students. For instance, the former BEC lasted approximately 12 years, with high school graduates attending college between the ages of 15 and 16. In the current curriculum, these numbers will increase by approximately two years. In addition, the number of male and female college students will increase as the number of college applicants rises. Lewine (2011) also explains that girls outperform males in terms of GPA and course withdrawal rate. In contrast, Voyles (2011) asserted that age, not gender, influences mathematics and reading evaluation scores. However, Mlambo (2012) revealed that gender and age do not influence the academic performance of biochemistry students. These studies highlight the challenges caused by the vertical mismatch of the senior high school curriculum and college courses. However, this research examined the substantial variations between the strands and the student's academic performance without considering the student's socioeconomic profile, including household income and college admission test results.

In the study conducted by Lumboy (2019), STEM graduates demonstrated significantly higher college academic performance than non-STEM graduates. Malaga and Oducado (2021) found that STEM graduates were better equipped to enroll in a specific medical course. The results of a much larger study including 79 higher education institutions (HEIs) in the Philippines revealed that

STEM graduates achieved the best levels of academic achievement when enrolled in health science programs (Alipio,2020). The study by Koretz et al. (2016) correlated high school assessments with the GPA of college freshmen and found that high school examinations have minimal effect on predicting the academic achievement of college students. In addition, Honken and Ralston (2013) demonstrated that the first semester GPA of high-achieving first-year students had an inverse association with their lack of self-control. Richardson, Abraham, and Bond (2012) confirm this conclusion in their analysis of the fifty (50) correlates of university grade point average, which revealed that self-efficacy has the strongest link. It is imperative to re-evaluate the existing school policy regarding career guidance programs. Providing proper guidance to students on the courses they should pursue in college would greatly benefit them. To address this, the high school curriculum and instruction should be aligned with the college requirements to bridge the gap (Quintos, Caballes, Gapad, & Valdez, 2020).

This study proposes that there may be strands that offer courses vertically linked with those of the Bachelor of Science in Biology, Bachelor of Science in Chemistry, and Bachelor of Science in Environmental Science degrees. The significance of identifying which pathways create students who are unable to achieve a desirable academic performance at the bachelor's level. Identifying the obstacles these underachieving kids face could serve as the basis for developing a program to improve their academic performance.

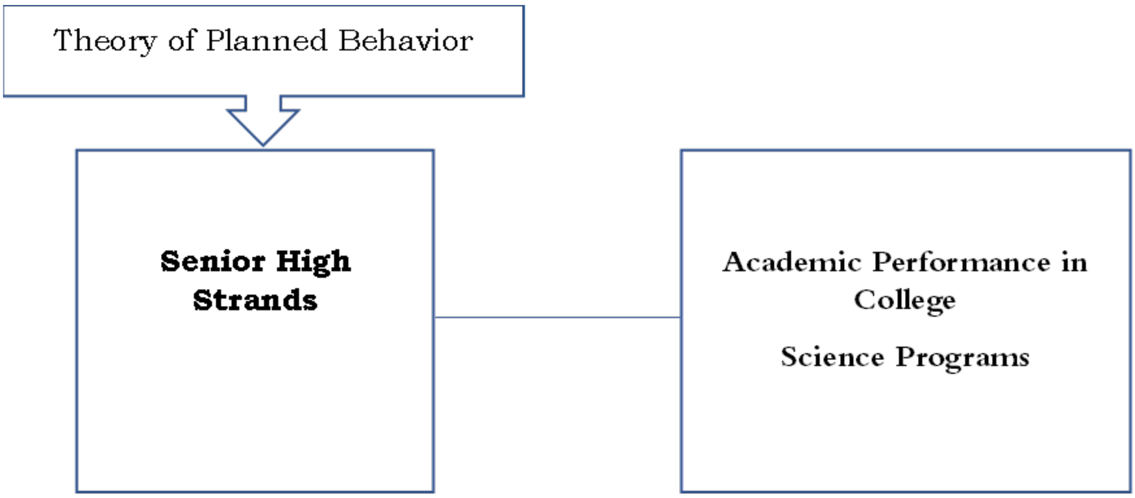

Figure 1 Theory of planned behavior and the effect of SHS strands on college academic performance

The Theory of Planned Behavior outlines the effect of an individual's behavioral intentions, which are defined by his or her attitude toward behavior, subjective norms, and perceived behavioral control (Ajzen, 1991). The hypothesis has been implemented and shown to be useful in predicting behavior patterns such as cheating, gambling, smoking, intentions to enroll in traditional or online classes, and social networking (Hoie, Moan, & Rise, 2019; Robinson & Doverspike, 2006). The study claims that strands in senior year of high school would influence students' intentions on their prospective college major based on their earlier behavior. In addition, previous conduct strengthens pupils' behavioral control, which will determine their behavioral accomplishment. As a result, the researcher will employ this theory as a conceptual framework for this investigation.

Research objectives

This study was done to determine if there is a Senior High School strand which produces high-achieving students in science-related programs. Specifically:

1.1 To determine the profile of the respondents according to the following:

1.1 Sex

1.2 Annual Family income

1.3 Senior High School Strand

1.2 To determine the academic performance of the respondents in select college science courses.

1.3 To test if there is a significant difference between the college academic performance of the respondents when grouped by sex.

1.4 To test if there is a difference between college academic performance of the respondents and their Annual Family Income.

1.5 To test if there is a significant difference between the college academic performance of the respondents and their senior high school strand.

Method

Research design

The study used a causal-comparative design to investigate the effect of the type of senior high school strand taken by the students, to their academic performance in college. This research design seeks to determine causal relationships in circumstances, achieved through comparing the different circumstances with observed effect. In this study, the differences between college academic performance of the respondents when grouped according to their sex, annual household income and Senior High School strand were tested.

Participants

The population of this study are the 3rd year students of the Bachelor of Science in Biology, Bachelor of Science in Chemistry, and Bachelor of Science in Environmental Science of the School Year 2020-2021 enrolled in two SUCs in the Province of Leyte. The researcher utilized a total enumeration sampling since the student population of the aforementioned programs are only few.

Setting

Two Philippine State Universities offer Science-related courses, namely: Bachelor of Science in Biology, Bachelor of Science in Chemistry, and Bachelor of Science in Environmental Science. This paper investigated the demographic profile (sex, annual family income, senior high strand) of sixty-one (61) college students enrolled in science-related programs in two different SUCs in the Province of Leyte, Philippines.

Data collection

This research was conducted methodically, beginning with drafting a letter to the university presidents of A and B requesting access to the respondents' General Weighted Average in Senior High School and in college. This study's goal and methodology were communicated to respondents via a letter sent to them separately. If respondents volunteered to participate, their demographic information, including gender, age, senior high school strand and annual household income, was recorded using a Google Forms survey questionnaire.

Method of scoring

The annual family income, Senior High School academic performance and College academic performance of the respondents regardless of their programs and delivering institutions were scored using the following ranges of scores and qualitative description.

Annual family income

The Annual Family Income was scored using the Income Classes used by the Philippine Statistics Authority (2020).

Under 40, 000 PHP

40,000 – 59, 999 PHP

60, 000 – 99, 999 PHP

100, 000 – 249, 999 PHP

250, 000 – 499, 999 PHP

500, 000 and over PHP

College academic performance

The College Academic Performance grading scale (Table 1) is based on the Revised Student Handbook of one of the SUC. The college academic performance is the general weighted average of the respondents from the first year to the third year and first semester.

Table 1 College grading scale

Grading Scale	Qualitative Equivalent
1.0	Excellent
1.5-1.1	Superior
2.0-1.6	Very Good
2.5-2.1	Fair
3.0-2.6	Poor
4.0-3.1	Very
5.0-4.1	Very Poor

Analysis of data

All the data were analyzed using descriptive and inferential statistical methods in JASP. A descriptive statistic, specifically the frequency count, was used to present and describe the respondents' demographic profile (sex, annual family income, and Senior High School strand) and the respondents' academic performance in college. The advantage of using a frequency count is that it allows a convenient way of looking into the data, showing whether observations are concentrated in one area or spread out across a full scale (Manikandan, 2011). The descriptive statistics used were frequency, percent, mean, and mode. The ANOVA test was used to test the significant difference between College Academic Performance and Senior High School strands. ANOVA determines statistical differences between means of more than two groups. The normal distribution cannot be calculated because the sample size per group is small (Lomuscio, 2021).

Ethical Considerations

The respondents of the study were informed about the purpose and the procedures of this study. Voluntary participation in this research was implemented. Hence, the participants can withdraw their consent and discontinue participation. Measures like using pseudonyms or codes during data analysis were undertaken to ensure that the research participants were not harmed during the study. In addition, the Google Form link used in this study was not shared with anyone else; only the researcher can access and edit the form. All the derived information was treated with the utmost confidentiality and solely used for the data analysis.

Findings

Table 2 displays the demographic profile of the respondents according to their sex, annual household income, and senior high school strands. Of the 61 respondents, 47 are female and 14 are male. Sixty percent (60%) of respondents fall below the 40,000 threshold for their annual household income. Only two respondents had a household income between 250,000 and 499,999 per year. For the Senior High School Strands, 15 respondents (24%) graduated from General Academics Strand (GAS) and 14 respondents (22%) graduated from the Science, Technology, Engineering and Mathematics (STEM) strand.

Table 2 Demographic profile of the respondents

Profile	Frequency (N)	Percent (%)
Sex		
Female	47	75
Male	14	25
Annual Household Income		
Under P40,000	37	60
40,000 – 59, 999	7	11
60, 000 – 99, 999	9	16
100, 000 – 249, 999	6	10
250, 000 – 499, 999	2	3
Senior High School Strands		
GAS	15	25
STEM	14	23
ABM	10	16
ICT	10	16
HUMSS	7	11
Home Economics	5	8

Respondents' College Academic Performance

Table 3 displays the academic performance of the respondents during their college years. The general weighted average of their academic performance from the first semester of their freshman year to the first semester of their junior year was used to evaluate their overall performance.

Ten (10) of the fourteen (14) STEM graduates have a very good college academic performance, while four (4) have excellent college academic performance. Meanwhile, ten (10) of the fifteen (15) Gas strand graduates show outstanding academic achievement. This suggests that STEM and GAS students have the highest academic performance compared to students from other disciplines.

Table 3 College academic performance by senior high school strands

Strands	Mean (Average Grade)	Standard Deviation	Interpretation
STEM	1.70	0.165	Very Good
Home Economics	1.96	0.169	Very good
GAS	2.00	0.331	Very Good
HUMSS	2.00	0.350	Very Good
ABM	2.04	0.338	Very Good
ICT	2.15	0.386	Fair

The STEM graduates have the highest mean academic performance (M=1.70, SD = 0.165), followed by Home Economics graduates. The ICT graduates have the lowest mean academic performance (M=2.15, SD = 0.385) among the six strands. This implies that STEM graduates in college-related courses outperform other strands in their college academic performance at least numerically speaking. Morados (2020) revealed that students from the STEM strand performed better than non-STEM graduates in mathematics courses.

In the study of Almerino et al. (2020) where they administered a standardized test called SATA, short for Scholastic Abilities Test for Adults, to grade 12 students, the results showed that the STEM strand students were outperformed by ABM students in the mathematical applications (MA) subtest. They argue that the due to the attractiveness of the STEM strand in terms of the possible job opportunities, it has become a 'melting pot' of students who are expected to fit and to lag behind the STEM program. Rafanan, De Guzman, and Rogayan, Jr (2020) support this statement since their studies have presented that many STEM students will not pursue STEM-related courses because some of them are not even interested in the strand at all. Factors like peer pressure, issue in course quota, and family issues contributed to such preferences. In addition, the lack of implementing guidelines in the selection of students in the strand could also be a source of flaws as the STEM program progresses. It can also be observed that during the first year of the K-12 implementation, senior high school teachers were often sent to training and seminars resulting to lack of time management in holding STEM classes (Tupas & Matsuura, 2019). Aside from that, many schools have high difficulty in implementing the STEM curriculum in their Senior High School programs brought about by the lack of laboratory facilities to aid in the instruction of teachers (Estonanto, 2017).

In Table 4, males (N = 14) were associated with the academic performance in college M = 2.057 (SD = .396). By comparison, females (N = 47) were associated with a numerically smaller Academic Performance M = 1.93 (SD = .308). To test the hypothesis that there is no significant difference in the academic performance in college when differentiated by sex, an independent sample t-test was performed. But upon checking the normality of the groups using the Shapiro-Wilk test, it was found out that the female group is significant (p=0.017). This means that one instead of using independent sample t-test, Mann-Whitney U was used since one of the groups is not normally distributed (Goss-Sampson, 2020). Additionally, the Levene's F test was done, F(61) = 1.49, p = .227, showing that the p value is not significant. This means that the data is normally distributed. Finally, the Mann-Whitney U test was associated with a not statistically significant effect (p >.05).

Table 4 Mann-Whitney U test result of the difference between college academic performance when grouped by sex

	W	p
College Academic Performance	273.000	0.338

Thus, there is no statistically significant difference for sex in terms of the academic performance in college, despite females having a smaller general weighted average than males. This finding is consistent with that of Rodriguez, Regueiro, Piñeiro, Estevez, and Valle (2020), which showed no significant difference in academic performance between male and female students. Goni (2015) also corroborates this claim as his study showed no significant difference between gender and academic performance of education students in Nigeria. Although some studies show significant differences between sex and academic performance, the result of this current study shows that there is no gender gap in the academic performance of pure science students.

Table 5 shows the ANOVA comparing the means of the different income classes based on the parameters used by the Philippine Statistics Agency (PSA) on the Academic Performance of the respondents in college. The data analysis showed that most of the respondents (N=36, M = 1.983) have an annual household income which is below ₱40, 000. Only two respondents have an annual household income of ₱250, 000 and over. The Levene's F test, p = 0.256, showed that the data is homogeneous.

Table 5 Difference between college academic performance when grouped by annual household income

Age	N	Mean	SD	Statistic	Df	p
under P40,000	36	1.983	0.330			
40,000 – 59, 999 PHP	7	2.043	0.166	0.564	3	0.641
60, 000 – 99, 999 PHP	10	1.880	0.353			
100, 000 – 249, 999 PHP	8	1.875	0.375			

Table 6 shows the difference between College Academic Performance when grouped by Senior High School Strands using ANOVA. The test showed a significant difference between college academic performance and senior high school strands, p = 0.018.

Table 6 Difference between college academic performance when grouped by senior high school strands

Age	N	Mean	SD	Statistic	Df	p
GAS	15	2.000	0.330			
STEM	14	1.700	0.166			
ABM	10	2.040	0.353	14.133	5	0.018
HUMSS	10	2.000	0.375			
ICT	7	2.150	0.356			
Home Economics	5	1.700	0.182			

A post-hoc analysis was done to determine which of the strands have a significant difference when compared to another strand. Upon performing the Dunn's posthoc analysis, it was revealed that the ABM-STEM (p = 0.006), GAS-STEM (p = 0.005) , HUMSS-STEM (p = 0.014), Home Economics-STEM (p = 0.031), and ICT-STEM (p = <.001) comparisons were significant. It could be noted that the STEM students have the highest mean academic performance (M = 1.70, SD = 0.165) among all other strands. Hence, STEM students have statistically better academic performance in science-related college programs compared to the students who finished non-STEM strands.

Table 7 Dunn's post-hoc results

Comparison	z	W_i	p
ABM - GAS	0.190	33.333	0.425
ABM - HUMSS	0.064	34.143	0.474
ABM - Home Economics	0.135	33.400	0.446
ABM - ICT	-0.811	41.100	0.209
ABM - STEM	2.531	16.214	0.006
GAS - HUMSS	-0.100	34.143	0.460
GAS - Home Economics	-0.007	33.400	0.497
GAS - ICT	-1.079	41.100	0.140
GAS - STEM	2.612	16.214	0.005
HUMSS - Home Economics	0.072	33.400	0.471
HUMSS - ICT	-0.800	41.100	0.212
HUMSS - STEM	2.196	16.214	0.014
Home Economics - ICT	-0.797	41.100	0.213
Home Economics - STEM	1.870	16.214	0.031
ICT - STEM	3.407	16.214	< .001

Conclusion

Although the State Universities and Colleges (SUCs) in the Philippines are mandated to accept all incoming tertiary students regardless of their strands, there must be a system of admitting these students in college programs that are aligned with what they have taken up in senior high school. College academic performance in science-related programs is unaffected by sex and annual household income so regardless of sex and the socio-economic status, students should be admitted to SUCs. On the other hand, senior high School strands affects college academic outcomes. As a result, science-related programs should consider the strand of the students prior to admission. A short-bridging program could also be conducted for non-STEM graduates who aspire to study in a science-related program.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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