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Abstract
Few people pursuing STEM careers is a source of worry in Zambia just like it is in many other countries globally. The study aimed at determining the effect of STEM and non-STEM career aspirations on the performance of pupils in STEM subjects. The study employed an ex post facto design. All grade eleven pupils in Kitwe District comprised the target population. Purposive sampling was used to select Schools while simple random sampling with replacement was used to select two classes at each school. An informal interview schedule and a STEM Achievement test were the data collection tools. Means and standard deviations were used to analyze the data while the ANOVA and the independent samples t-test were used to test for any statistically significant difference across the two groups. The posttest ANOVA gave a statistically significant result of career aspiration and Gender with F (1,450) = 4654.900, p < 0.05 and F (1,450) = 1172.151, P < 0.005 respectively. Career aspiration by Gender interaction was non-significant with F = (1,450) 0.164, P > 0.05. This means that performance in STEM subjects varies with career aspirations and gender and that the two variables do not interact to influence Achievement in STEM subjects.

INTRODUCTION
Zambia, just like other countries is committed to increasing the number of STEM professionals because STEM careers have become an ingredient for any Country to function effectively in an increasingly competitive global economy (Archer et al., 2013). To increase the number of people pursuing STEM careers, countries should have individuals with the relevant basic understanding of STEM subjects. Several studies have shown that pupils in Secondary schools perform poorly in STEM subjects in Zambia (ECZ, 2014, 2016, 2018; Musonda, 2019).

This is a source of concern because STEM subjects offered in Secondary Schools are aimed at equipping pupils with basic concepts necessary to undertake STEM-related careers at the tertiary level of education. Findings of many Scholars suggest that teaching approaches, attitude towards STEM subjects and career aspirations significantly affects performance in STEM subjects (Manda et al., 2019; Nyacomba ., 2017; Musonda, 2019). In her study titled “Relationship between students’ Mathematics Achievement and Career Aspirations in Secondary Schools of Kandara sub-county in Kenya”.

Nyacomba (2017) found that there is a significant relationship between student’s aspirations and their Achievement in mathematics. This implies that students’ career aspirations will determine the subjects they will be interested in learning and consequently their performance in those subjects and vice versa. While a lot of research has been conducted to determine the effective methods in teaching various STEM subjects with the intent of improving performance, little attention has been given to determining students’ career aspirations and how these affect their performance in STEM subjects.

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Problem Statement

The issue of few people in STEM fields start from poor the performance of pupils in STEM subjects in Secondary Schools to the dwindling numbers of STEM professionals globally (Archer et al., 2013; ECZ, 2013, 2014, 2016, 2017; Nyacomba, 2017). Today across the world, great emphasis is being placed on the importance of STEM subjects in the curriculum Nyacomba, 2017; Musonda, 2019). It has been argued that STEM subjects play a vital role in the development of every Nation. This is to say the teaching and learning of STEM subjects in Secondary schools should be meaningful if nations are to produce STEM competent citizens to take up STEM professions in sufficient numbers for the attainment of meaningful national development.

The Zambian Secondary education is, however, characterized by poor performance in STEM subjects (ECZ, 2014, 2015, 2016, 2018; Musonda, 2019). In the light of the above evidence, the study’s objective was to establish the effect of STEM and non-STEM career aspirations on pupils’ performance in STEM subjects in Secondary schools.

Purpose of the Study

The purpose of the study was to determine the effect of pupils’ career aspirations on their performance in STEM subjects at three selected Co-education Secondary Schools in Kitwe District.

Objectives

1. To establish the effect of pupils’ career aspirations on their performance in STEM subjects in secondary schools.
2. To find out whether career aspirations are influenced by gender.

Research Questions

The following research questions were asked in this study;

1. What is the effect of career aspiration on Performance in STEM subjects?
2. Are career aspirations influenced by gender?
3. Does Gender influence performance in STEM subjects?

Theoretical Framework

This study endeavored to determine the relationship between pupil-career aspiration and performance in STEM subjects. This study was informed by the Social Cognitive Career Theory (SCCT). In this theory, Lent et al., (1994) stated that individuals can establish functions they would love to perform, and things they would love to alter and achieve. Individuals possessing high self-esteem directs their efforts to achieving challenging tasks and vice versa.

This implies that learners with confidence in their abilities have expectations and give the maximum commitment to what they desire to achieve. Those learners with low self-esteem, however, have low expectations and so are not very committed to challenging tasks. The three general social cognitive factors of the SCCT including self-efficacy, outcome expectation and personal goals influence career expectations and consequently performance in STEM subjects (Lent et al., 2000).
METHOD

Study Area

This study was conducted in Kitwe district on the Copperbelt province. The specific schools were the study was conducted include Malela, Matete and Mindolo Secondary Schools. All the three schools are Co-education Secondary Schools.

Research Design

The study used a quasi-experimental design, specifically the ex post facto design. This design was suitable for this study because there was no random assignment and manipulation of variables. The study was interested in the effect of career aspirations already possessed by pupils on their performance in STEM subjects.

Target Population

All Grade eleven Secondary School pupils in Kitwe District constituted the target population. Grade eleven were chosen because they were non-examination classes and have been in Secondary School for almost two years and as such are expected to have high career aspirations.

Sample and Sampling Techniques

Purposive sampling was used to select co-education Secondary schools in Kitwe because the study was interested in schools with both boys and girls. The three co-education Secondary Schools were then selected using simple random sampling with replacement using the lottery method. Two grade eleven classes at each of the three selected Secondary schools were also selected using simple random sampling. Grade eleven classes were preferred because they already had been in Senior Secondary education for almost two years and have a lot of career aspirations. Grade twelves would have been the best target, however the researchers did not want to disturb them because of being an examination group.

Data Collection Instruments

An informal interview and a STEM Achievement Test were the data collection tools. Interviews were done informally to make pupils free to express their career aspirations while the Achievement test gathered data on pupils’ performance in STEM subjects.

Validity and Reliability

The Achievement tests was validated by content validity. Equivalence reliability which involves administering two kinds of a test instrument to the same group on the same day at different times (Gray, 2009) was used to ascertain the reliability of the Achievement test. The degree of reliability was then measured by the Cronbach’s alpha. According to (Gray, 2009), the coefficient of 0.9 is deemed acceptable.
Ethical Issues

Research ethics can be defined as norms that govern the implementation of a scientific study. During the study, researchers were mindful of the research ethics and as such, consent was sought from respondents, School Headteachers and the motive behind the study explicitly explained. The researchers were honest enough to go back to the schools where the study was conducted to communicate the findings. Researchers also followed the school timetable during the study to avoid disrupting the normal School routine. Additionally, the respondents were treated equally as they were exposed to the same teachers and teaching methodologies during the study to eliminate any form of biases (Shamoo et al., 2007).

Data Analysis

The data were analyzed using descriptive statistics such as means and standard deviations. Cross tabulations were used to summarize the data, the ANOVA and t-test were used to test for any statistically significant differences in mean achievements of Pupils’ with STEM career aspirations and those with non-STEM career aspirations. These computations and analyses were all done using the Statistical Package for Social Sciences (SPSS) version 20.

FINDINGS

Sample Descriptive Statistics

Having interacted with pupils in an informal interview, the number of pupil’s with STEM and non-STEM career aspirations by Gender were ascertained. The two groups of pupils categorized as STEM and non-STEM career aspirations were then taught STEM subjects for three weeks (Mathematics, Physics, Biology and Chemistry). One topic from each subject was taught by an educator in their respective fields, for instance, Biology was taught by a Biology educator and so on. At the end of a period of instruction, a STEM Achievement test (A test containing Mathematics, Physics, Chemistry and Biology questions) was administered and the results obtained from this test are presented in Table 1.

<table>
<thead>
<tr>
<th>Career Aspiration</th>
<th>Gender</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>118</td>
<td>45.52</td>
<td>6.490</td>
</tr>
<tr>
<td>Non-STEM</td>
<td>Female</td>
<td>176</td>
<td>33.57</td>
<td>9.501</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>294</td>
<td>38.37</td>
<td>10.253</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>107</td>
<td>70.39</td>
<td>9.940</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>52</td>
<td>57.73</td>
<td>6.158</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>159</td>
<td>66.25</td>
<td>10.679</td>
</tr>
<tr>
<td>STEM</td>
<td>Female</td>
<td>52</td>
<td>57.73</td>
<td>6.158</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>159</td>
<td>66.25</td>
<td>10.679</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>225</td>
<td>57.35</td>
<td>14.959</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>228</td>
<td>39.08</td>
<td>13.465</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>453</td>
<td>48.15</td>
<td>16.897</td>
</tr>
</tbody>
</table>

It is evident from Table 1 that, more pupils (294 out of 453) have non-STEM career aspirations compared to those with STEM aspirations. Table 1 also shows that there are more male pupils aspiring to pursue careers related to STEM than females and that male students exhibited a higher average achievement than females in STEM subjects both in the group with STEM and non-STEM career aspirations.
Levene’s Test

The Levene’s test was conducted on the STEM Achievement test results to determine whether equal variances were assumed. The results of this test are outlined in Table 2.

Table 2. Levene’s Test for equality of Variances

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>F</th>
<th>df1</th>
<th>df2</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Career aspiration</td>
<td>0.007</td>
<td>451</td>
<td>312.872</td>
<td>0.935</td>
</tr>
</tbody>
</table>

Table 2 shows a non-statistically significant result with $F (451, 312.872) = 0.007$, $P = 0.935$. This means that the variances across the two groups were equal despite having different career aspirations.

Analysis of Variance (ANOVA)

The ANOVA is a statistical test that is used to compare means between groups that are separated on independent variables. The primary purpose of the ANOVA is to understand whether there is an interaction between the independent variables on the dependent variable, that is, whether career aspiration does influence Achievement of pupils in STEM subjects based on Gender? In this study the ANOVA was conducted after a period of teaching and learning to determine whether pupils in the two categories of career aspirations differed on the dependent variable (average Achievement).

Table 3. Posttest Analysis of Variance (ANOVA)

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Career aspiration</td>
<td>1</td>
<td>56260.652</td>
<td>56260.652</td>
<td>4654.900</td>
<td>0.009**</td>
</tr>
<tr>
<td>Gender</td>
<td>1</td>
<td>14167.007</td>
<td>14167.007</td>
<td>1172.151</td>
<td>0.019*</td>
</tr>
<tr>
<td>Career * Gender</td>
<td>1</td>
<td>12.086</td>
<td>12.086</td>
<td>0.164</td>
<td>0.686</td>
</tr>
<tr>
<td>Residual</td>
<td>450</td>
<td>36.258</td>
<td>36.258</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>453</td>
<td>70476.003</td>
<td>70476.003</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Career aspiration and Gender show a statistically significant result with $F (1, 450) =4654.900$, $P<0.05$, and $F (1, 450) = 1172.151$, $P<0.05$ respectively. This implies that pupils’ with STEM career aspirations exhibit higher average Achievement in STEM subjects than those with non-STEM career aspirations. Table 3, however, indicates a non-significant interaction effect of Gender and career aspiration with $F (1,450) = 0.164$, $P > 0.05$. In other words, career aspiration is not influenced by Achievement in STEM subjects based on Gender. The independent samples t-test also gave a statistically significant result with $t (453) = -27.226$, $p = 0.000$ on career aspirations and $t (453) =13.661$, $p=0.000$ on Gender.

DISCUSSION AND CONCLUSION

The findings of this study show that performance in STEM subjects in Secondary schools is influenced by the pupils’ career aspirations which and gender. The findings of this study are discussed in this section according to the research questions that guided the study.

Research Question 1: What is the effect of STEM and non-STEM Career Aspiration on Performance in STEM subjects?

In this study, pupils with STEM career aspirations exhibited a higher average Achievement than those with Non-STEM career aspirations. This suggests that performance in STEM subjects’ influences career aspirations. A chapter by Tytler and Osborne on students’ attitudes and Aspirations towards
Science in Fraser et al., (2012), students’ perceptions of subject difficulty was stated as one of the variables determine whether one will aspire a career to do with such a subject or not. That is to say, high Achievement in STEM subjects’ increases in students’ self-confidence which results in the development of positive attitudes towards these subjects and consequently their aspirations to pursue STEM careers. In his study, Lyons (2006) also found that high achieving year 10 students in Australia exhibited higher levels of self-efficacy which according to him was an important factor in deciding to take these subjects which are famous for their toughness. Additionally, Menon et al., (2014) in their study on the career interests of young people in Zambia stated that, achievement helps recognize career preference. Simply put, there is a relationship between Achievement in STEM subjects and having a STEM career choice. It is not very clear, however, whether Achievement influence career choice or vice versa.

Research Question 2: What is the effect of Gender on Career Aspiration?

The findings of this study suggest that career aspiration is influenced by Gender with more males aspiring to pursue STEM-related careers than females. This is in agreement with Menon et al., (2014) who found that most females chose careers in social fields while more males chose careers in scientific and technical (STEM) fields. Similarly, Fraser et al., (2012) found gender to be one of the three most significant factors determining student interest in science. Interest is a very important ingredient in the learning process because when students are interested in what they are learning, the attainment of lesson objectives become most likely (Bloom, 1976). The chances of pursuing careers in STEM subjects also increases with the increase in interest in learning STEM subjects. In other words, low motivation in School Science, Mathematics and Technical subjects by msany girls results in few girls aspiring to pursue careers in STEM fields. In this study, the results presented in Table 1 show that males have a higher average Achievement than boys, and the group with STEM career aspirations a higher average Achievement than the non-STEM group in STEM subjects. These results are very informative and imply that a relationship exists between career aspiration and performance in STEM subjects.

Research Question 3: Does Gender influence performance in STEM subjects?

The findings of this study indicate that performance in STEM subjects is influenced by Gender in favor of boys. These results are in agreement with the findings of several studies such as (Amedu, 2015). Various reasons have been attributed to this Gender difference in terms of Achievement in STEM subjects. Fraser et al., (2012) for example noted that many females have low interest in school science and hence their low average Achievement compared to boys. Low interest in School Science and other STEM subjects can be attributed to factors such as societal beliefs and teaching styles which discriminate females among other factors. Even though some studies suggest that females perform better than males (Botcherby & Buckner, 2012; Niederle & Vesterlund, 2010), while others show that there is no significant difference in the average achievement of boys and girls(Goni et al., 2015; Milun et al., 2012), may studies seem to agree that males on average perform better in STEM subjects than their female counterparts (Chan & Cheung, 2018; Sobieraj & Krämer, 2019).

To sum it up, the findings of this study indicate that students with STEM career aspirations are those that on average perform better in STEM subjects than those with non-STEM career aspirations. This has also been proved by the fact that girls exhibited a low average Achievement than boys, and consequently few girls indicated that they had STEM career aspirations compared to boys. More research is therefore neccesary to understand how Achievement and career aspiration interact, and to also determine the measures to put in place to increase the number of men and women in STEM proffessions.
Recommendations

Pupils with high Achievement in STEM subjects are most likely to have STEM career aspirations. The clear relationship between the two variables, however, is yet to be established as many factors influence achievement in STEM subjects. It is therefore, recommended that further studies be undertaken to explore the relationship between these two factors, and other variables that influence STEM career choices. More research to explore context based factors region by region that affects low motivation in School STEM subjects by many girls and how these factors can be addressed to increase the number of women in STEM careers is also recommended. Determining context based factors influencing STEM career aspirations by secondary School pupils is key to determining ways of increasing the number of individuals in STEM professions in the country.

Acknowledgements

The researchers’ wish to acknowledge the roles played by the School managers of the three schools were the study was conducted as well as the grade eleven pupils’ who participated in this study in the 2019 academic year. To you all we say your contributions are highly appreciated.

REFERENCES


