



FACTORS MOTIVATING FEMALE STUDENTS FROM MASVINGO, ZIMBABWE - THE CHOICE OF TAKING NATURAL SCIENCES AT UNIVERSITY

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Abstract:

Although there is a demand for the requirement for natural sciences skills, to date, the connection between natural sciences subject choices and their impact on female students' educational pathways has not been widely studied. Natural sciences include Mathematics, Physics, Chemistry, Computer Science and Geography. In this paper we therefore investigate the factors that motivate Zimbabwean female students to choose natural sciences at university. The main body of data for the research was generated through semi-structured interviews. The preliminary results reflect that there are three are the main factors that motivated female students in the sample to choose natural sciences programmes: (1) self-efficacy, ability (2) the influence of their female teachers, relatives, parents and friends (3) relevance of natural sciences. Hence these three factors promote the constitution of a natural science identity, which in turn motivates the choice of natural sciences as a career female amongst female students.

Keywords: female natural science students, Masvingo students, natural science identity

1. Introduction

There has been an investigation and analysis that worldwide there is generally a low number of tertiary students taking up natural sciences (Stine & Matthews, 2009). Additionally, the female enrollment in natural sciences is lower than the male one. Numerous studies have been done on the reasons for the gender differences in natural sciences (e.g., Allen & Eisenhart, 2017; Perez, Cromley, & Kaplan, 2014). As a result, Wang and Degol (2016) discussed on six different reasons for underrepresentation of female in natural sciences. The reasons that were pointed out were (a) cognitive ability, (b) relative cognitive strengths, (c) occupational interests or preferences, (d) lifestyle values or work/family balance preferences, (e) field-specific ability beliefs, and (f) gender-related stereotypes and biases.

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Notwithstanding the challenges of attracting more female students to study natural sciences, little research has been done in Zimbabwe based on identifying the factors that may captivate and retain female students to study natural sciences in this province. Some studies in Zimbabwe that have been done highlighted on participation of rural Zimbabwean female students in mathematics (Gudyanga, Mandizvidza, Gudyanga, 2016) as well as on Zimbabwe female participation in physics by Gudyanga (2017). The former research highlighted on the influence of perception to the performance of female students and the later analysed on how Zimbabwean female adolescent students' images of scientists have an impact on their participation in physics.

In this paper, a presentation of an ongoing research aimed on investigating some of the factors that may encourage Masvingo female students to choose natural sciences as a career is done. The main contribution of this paper is to assist in understanding the factors that motivates female students from Zimbabwe to opt for natural sciences as a field of study. This research could bring light in comparing and contrasting some motivating factors to enroll for natural sciences programmes, among females from different countries. Pedagogical recommendations to promote the study of natural sciences by Zimbabwean females.

The paper is organized as follows: firstly a summary of the literature review and its contribution to this research is presented, secondly the method of approach on collecting and analysing empirical data is discussed; thirdly, some preliminary results are presented, that is, some of the factors that seem to motivate Zimbabwe female students to choose natural sciences as a career; fourthly, some theoretical tools on concepts of self and identity are linked to the results obtained; finally the conclusion of the research is presented.

2. Literature Review

To attain the demand in natural scientist, has been a global concern as these careers have a strong impact in the development of the present day society. Scholars like Ukeje (1997, cited in Aguele & Agwagah, 2007) remarked that, "*...without mathematics there is no science, without science there is no modern technology and without modern technology there is no modern society.*" As the size and composition of the natural sciences workforce continuously fails to meet the demand (Jang 2016; Wang & Degol, 2016), it is crucial to scrutinise the hindrances and factors that influence individual education and career choices (Blotnick, Franz Odendaal, French & Joy, 2018). Self-efficacy beliefs have an influence in giving rise to different carrier selection. This is supported by social cognitive career theory which points out that career interest, choice, and personal goals form a complex human agency process that includes performance, self-efficacy, and outcome expectations (Bandura, 1986; Lent, Brown, & Hackett, 1994).

For Zimbabwe to thrive economically, the study of natural sciences should be given passable recognition in the different levels of the countries' education. Zimbabwean primary school curriculum includes subjects such as English, mathematics,

agriculture, indigenous languages and computer science. In secondary schools, natural sciences are not compulsory with the exception of mathematics and science as cited in Herald 2011. The importance of ordinary and advanced level school subject choices is currently increasing, as student selection to the universities will be more heavily based on the results of the advanced level examination.

Although mathematics and science have become mandatory subjects in Zimbabwean secondary curriculum, a great number of female students mainly at Ordinary Level lose their focus in mathematics (Herzig, 2004). It was noted that, *“mathematics is the precursor and the queen of science and technology and the indispensable single element in modern societal development”* Ukeje (1997, cited in Aguele & Agwagah, 2007). According to Masanja (2010) rural areas have a bad situation whereby a very low number of female students and teachers is found participating in science and mathematics. A low number of Ordinary level female students who excel in mathematics has a great impact on the number of female students who would take up natural sciences at advanced level and thereafter at degree level. University student admission into under-graduate studies is based on advanced level results. However, for other university programmes with the exception of natural sciences there is also a facility for mature entry (people aged twenty-five years and above, with five ‘O’ level passes including English and relevant working experience). This gives a contribution to a low number of students doing natural sciences in general.

The situation in Zimbabwe, where this study is being established, there is generally a low female students’ enrollment in natural sciences. The participation of female students in natural sciences at high school level is low compared to males. The latest figures on the study of undergraduate natural sciences student enrollment at the university in Masvingo show that women represent 20% of the people studying a bachelor degree in natural sciences; there are numerous factors that have an influence on the university programme selection. The authors Palmer, Burke, and Aubusson (2017) applied a best-worst scaling survey to evaluate the relative importance of factors that have an impact on students’ programme selection decisions. With reference to their findings, crucial factors in both selecting and rejecting subjects which students highlighted were enjoyment, interest and ability, and perceived need in their future career plans. They considered advice classroom teachers, parents, or peers to be relatively less important.

According to several scholars, enhancing students’ enjoyment, interest, and perceptions of their ability in science, and their attitude towards it, as well as increasing student perceptions of the value of science in a future career may motivate more students to study science at school (Osborne, Simon, & Collins, 2003; Palmer et al., 2017). A crucial issue again is on the teacher’s role which enhances the quality of natural science education. This is supported by Slavit, Nelson and Lesseig (2016) who postulated that a teacher’s role is a complex mixture of learner, risk-taker, inquirer, curriculum designer, negotiator, collaborator, and teacher. It is paramount to comprehend teachers’ own beliefs and perceptions related to promoting natural science talent. It was discovered that

teachers with increased confidence in teaching would likely be more effective and increased confidence leads to better performance, which benefits the learning of the student (Margot and Kettler, 2019). According to Bottia, Stearns, Mickelson, Moller, and Valentino (2015) the proportion of female math and science teachers at school had no negative impact on male students, but it had a negative impact on female students' likelihood of declaring and graduating with a natural science degree.

Nonetheless, of late there has been an attentiveness in having distinctive and gender balanced scientific personnel. As a result, this has captivated a lot of research on establishing factors that fascinate and reserve students to natural sciences (see for example Brickhouse, Lowery & Schultz, 2000; Herzig, 2004; Hill & Rogers, 2012; Mendick, 2005). In this research, we are specifically interested in identifying the factors that fascinate and retain female students in natural sciences.

By appreciating the reasons leading to different programme selection, the existing gaps in our education system can be identified and hence craft ways for education system to motivate school female students in visualising the modern, growing natural sciences carrier opportunities.

The reason why the shortage of women in natural sciences remain evident was investigated by Dasgupta and Stout (2014). Their study highlighted to different hindrances specifically pointing to three developmental periods: (a) childhood and adolescence, (b) emerging adulthood, and (c) young-to-middle adulthood. Additionally, they also examined how specific learning environments, peer relations, and family characteristics can be hindrance to natural sciences interest, achievement, and persistence in each period. They discovered some key hindrances: (1) in childhood and adolescence, masculine stereotypes about parents' expectations of girl child, peer norms, and a lack of fit with personal goals make girls move away from natural sciences fields; (2) in emerging adulthood, feeling like a misfit in natural sciences classes, being vastly outnumbered by male peers, and lacking female role models make women avoid natural sciences majors or leave prematurely; and (3) in early to mid-adulthood, subtle gender bias in hiring and promotion, biased evaluation of scientific work, non-inclusive department climates, juggling work/family responsibilities, and difficulty returning after a family-related pause undermine the retention of women in natural sciences. To overcome these hindrances, Dasgupta and Stout (2014) suggested that evidence-based programs and policies be implemented during each of these developmental periods.

On another note, Su, Rounds, and Armstrong (2009) highlighted that males prefer working with objects where as females prefer working with people. This is also supported by Linnansaari et al. (2015) who pointed out that girls have a tendency of being interested in life science lessons and uninterested in physical science lessons which is contrast to boys. Girls would regard natural sciences as monotonous, challenging and irrelevant (Williams, Stanisstreet, Spall, Boyes, & Dickson, 2003). For students to study natural sciences, students require high levels of interest, skills, and desire for challenges (Wang & Degol, 2017, Linnansaari et al., 2015).

Natural sciences identity may be associated with academic performance and flourishing in undergraduate physics courses at the end of the term, particularly for women (Seyranian et al., 2018; Vincent-Ruz & Schunn, 2018). The role of self-efficacy beliefs and the nature of science identity has also been widely investigated (Pajares & Miller, 1994; Pajares & Urdan, 2006; Vincent-Ruz & Schunn 2018). The scholars Parker, Marsh, Ciarrochi, Marshall, and Abduljabbar (2014) found (a) a strong relationship between achievement, self-efficacy, and self-concept in natural sciences at age 15; (b) both self-concept and self-efficacy being independent and similarly strong predictors of tertiary entrance ranks at the end of high school; and (c) self-concept as a significant predictor of undertaking post-school studies in science, technology, engineering.

The literature review had a dual role in our research. On one side, it enabled the researcher to identify some of the methods implemented in the literature to identify the factors that may encourage female students to study natural sciences. On the other side, the literature review gave some general possible explanations on why some females are attracted to natural sciences carriers.

The methods employed are questionnaires in conjunction with other instruments, and open interviews that gave an opportunity to female students to outline about their experiences with natural science subjects (see for example Mendick, 2005; Piatek-Jimenez, 2008; Solomon, 2012). The explanations for the reason why some female students choose to enroll or (not to enroll) in natural sciences-related careers, are very diverse in nature. Some scholars claim that natural sciences can be regarded as unfeminine profession, hence a discrepancy between female identity and a natural science identity (Piatek-Jimenez, 2008; Solomon, 2012). The low number of females in the field of study of natural sciences can be as a result of intensive discrimination against women in natural science fields (Ceci, Williams & Barnett, 2009). Some professionals also suggest that most female students do not socially appreciate creativity required in some hard sciences hence a low number of female students in natural sciences (Hill & Rogers, 2012).

The two factors that have been postulated as encouraging and an inspiration for female students to engage in natural science programmes are: (1) individual confidence in their own intellectual abilities (Eccles, 2007) and (2) positive influence of significant persons, such as parents, teachers and friends (Sjaastad, 2012). In the review of literature, it was also noted that some studies associate the process of choosing a career has to do with the construction of an identity in students.

Holmegaard, Ulriksen & Madsen (2012) associate the choice of a career with the action of defining oneself: *“The decision about which course of study to choose after finishing upper-secondary school is not limited to figuring out what could be interesting or promising; it is also about defining oneself, and making a decision about whom one wishes to become”*. The theory of identity reflects what makes an individual associates himself or herself with a capable natural science student and eventually partakes in natural sciences activities (see for example O’Hara, 2010).

3. Material and Methods

After carrying out literature review, we noted some of the factors that motivate female students to enroll for natural sciences and then conducted an exploratory study. The purpose of this exploratory study was to verify whether the factors discussed in the literature do exist in Masvingo female students as well as to identify other possible motivating factors that were not discussed in the literature. The implementation of exploratory research paved way for the researcher to obtain an unified overview of the undergraduate female students' opinions regarding their motivating factors to natural sciences at one university in Masvingo, Zimbabwe.

3.1 Description of the Exploratory Study

A questionnaire was issued to 28 Masvingo female students studying bachelor's degrees in natural sciences in three different universities departments. The questionnaire was administered during September 2020 . The chairpersons of natural sciences departments administered the questionnaires to randomly selected students. Female students of 18 to 23 years selected were enrolled for different degrees programmes in the faculty of Natural sciences.

The questionnaire comprised of twelve open questions based on students' exposure to natural sciences before enrolling into university as well as their rational for studying natural sciences degree. The questionnaire encompassed questions like:

- a) What motivated you to choose the natural science profession?
- b) Upon which time in your life did you resolve to study natural sciences at university and why?

The two open questions facilitated the female students to uncover some of the reasons in studying natural sciences.

Some of the reasons reflected in the questionnaire include that:

- a) Their female natural science teachers inspired them to study natural sciences.
- b) Their family and friends influenced their choice of profession.
- c) Engaging in competitions like science competitions for high schools, mathematics Olympiads stimulated them to study natural sciences.
- d) Someday they became aware of their ability, appreciation and competence in natural science subjects as well as of the applications of these subjects hence thereafter the resolution to take up natural sciences.

An interview guide was then designed for semi-structured interviews from which we created the main body of data for the research.

3.2 Data Collection through Semi-structured Interviews

In this second stage of the research, the researcher chose to collect data using face-to-face in-depth interviews for 28 female students aged 18 to 23 years enrolled in one university in Masvingo, Zimbabwe. The students were in different departments of faculty of natural sciences.

The interviews took place between September and October 2020. The student involvement was non-mandatory, and the interviews were conducted during interlude time between lectures, at sports ground of the Institute for a relaxed and comfortable environment for the students.

The interviews were audio recorded and an average time of 10 minutes was allocated to each interviewee. The semi-structured interview document had a couple of open questions directed at activating students' statements on the activities and experiences that stimulated them to study natural sciences.

The open questions were:

- 1) Briefly describe one or more past experiences or activities that motivated you to choose this profession?
- 2) did you have any challenges in your profession selection?
- 3) Was it your intention from the beginning to study natural sciences or was there any specific event that that compelled you to choose this profession?
- 4) What did you esteem in your natural science teachers and their teaching?
- 5) How would you outline your experience in the Olympiads and natural sciences high school competition? State the reasons for their positive or negative impact?
- 6) Describe the contribution from your family and friends in motivating to choose a natural science profession?

3.3 Data Analysis

Analysis of interviews was done by distributing the audio recordings among all members of the research team. During the analysis of the audio-recorded interviews, the objective was to focus on what motivated the female students to study natural sciences. Two independent researchers analysed the recordings to increase the reliability and authenticity of the results. For any inconsistency in the interpretation of the interview, both researchers explicitly harmoniously deliberated about how they were expounding the content of the interview. The results presented below are established on the analysis of ten interviews.

3.4 Ethical Issues

Research ethical issues were observed at all stages of the study with particular attention to consent and confidentiality (Creswell, 2014; Marshall & Rossman, 2011). All the participants willingly engaged in this study. The information provided by participants during data collection did not reveal their identity as anonymity was enhanced by using codes. The reason for anonymity in the study is that the information provided by participants should in no way reveal their identity (Gilbert, 2011; Silverman, 2010).

4. Results and Discussion

The results presented in this section, reflect the factors that ten Masvingo(in Zimbabwe) female students revealed in their detailed account as stimulating to study natural

sciences. During the interview, some female students stated more than one stimulating factor . The researcher has classified the factors into six classes.

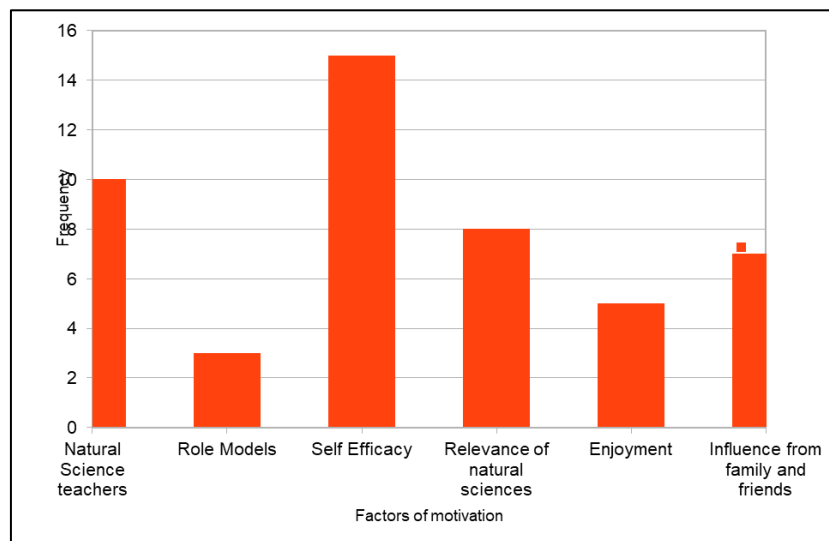


Figure 1: Some factors that motivate the female students in our sample to study natural sciences

4.1 Detailed Explanation of Each Class

4.1.1 Natural Science Teachers

The natural science teachers are the second most stated motivating factor amongst the female students. There are diverse characteristics that students point up about their teachers: Some of the students mentioned that they liked the way their natural science teachers deliberated their lessons. The lessons were practically based with clear, detailed explanation of the topics. The practical lessons which were carefully planned and managed gave them a feel for a phenomenon, developed their conceptual understanding and helped to learn about the nature of science.

Others highlighted that the few female natural science teachers who taught them gave them an inspiration to pursue the natural science field. They transmitted the lessons with enthusiasm and conveyed to them the love for natural sciences. Role models are very critical in enhancing confidence and elevating aspirations of female learners (Vurayai, 2012).

Some students, as illustrated in the following summary, outlined that the extra co curriculum activities such as natural science competitions(for example in quiz form), educational tours and mathematics Olympiad gave them the zeal to pursue the field of natural sciences. They managed to see the application and practical side of the subjects that aroused their interest.

“The educational tours we had with our teachers highly motivated me as we saw the application and practical side of the concepts taught by our teachers. I got interested in the field as I saw the essence of science” . (Student A)

4.1.2 Role Models

Role models are people whose behaviour, exemplary life or success serve as an inspiration to students. One student mentioned that a forensic scientist who stayed in their neighbourhood. She emulated everything on him. The type of life he led, the type of cars he drove and the type of clothes he wore.

“I really admire the forensic scientist who stays in our neighbourhood. I greatly got motivated to be a forensic scientist.” (Student G)

4.1.3 Self Efficacy

The main motivating factor mentioned by the students was that, during their education they realised their potential in natural sciences. They learnt natural sciences excelling in the exercises, tests and examination with little effort applied. Additionally, the complements they received from their teachers after excelling enabled them to realise that they were good in the subjects. The social recognition they received from peers who needed assistance in the subjects. They could solve problems without any struggling as compared to their peers. During quiz competition and Olympiads, they would come do well which gave them self-recognition of their natural scientific skills. When one student was asked the motivating factor to do natural sciences, she responded as follows.

“I just feel I am good in natural sciences and I want to learn more.” (Student D)

4.1.4 Relevance of Natural Sciences

There were five students who stated that they realised that natural sciences have more job opportunities which are well rewarding as compared to other fields. Some students also stated that the educational tours they had at school gave them an insight of natural sciences having many applications. Some also stated that the advertisements on television, internet and newspapers which prompted a girl child in natural sciences also contributed as a motivating factor.

The following is a transcript of one of these events:

“During high school education, my science teacher would introduce his lessons by stating that science is everything and everywhere. This then drew my attention to know that there are many applications of science and everything has to do with natural science.” (Student F)

4.1.5 Influence of their Family and Friends

The family plays a vital role in motivating students. There was a student who noted that she was inspired by some family members who had a natural scientific job and were living a prosperous life. The positive complements and presents they received from parents for good performance in natural sciences gave them the motivation to pursue

studies in natural sciences. Some said that it is friends who recommended them saying that natural sciences are doable and interesting.

Interviewer: *“How did your parents react when you told them that you wanted to pursue studies in natural sciences?”*

Student E: *“My mother was a chemistry teacher, so she encouraged me saying , it is an interesting area and I have made a good decision.”*

4.1.6 They Enjoy Doing Natural Science Subjects

Some mentioned that they got motivated to do natural science subjects as they had interest in them and hence enjoyed learning them. One student said When asked why they enjoyed learning natural sciences, one student said that the exactness in nature of the subjects gave them pleasure in solving them. However, some students find it challenging to elucidate their reasons:

Interviewer: *“Can you explain why do you enjoy doing natural sciences?”*

Student B: *“Well, I enjoy putting on lab coats.”*

Interviewer: *“Why do you like natural sciences?”*

Student C: *“I just enjoy doing natural sciences . I don't know how l to say it, I feel it is interesting to be called a scientist.”*

6. Conclusion

From the presented preliminary results, the study reflected that there are three main factors that influence Masvingo female undergraduate students to choose natural sciences as a profession:

- 1) Self efficacy,
- 2) Relevance or usefulness of natural sciences,
- 3) The influence of their mathematics teachers, peers and family.

Most of Masvingo female students consider natural sciences as masculine subjects. They regard them as more demanding and challenging, hence opt for social sciences, bachelor of arts degrees or going to teaching colleges and nursing schools. This has contributed to a low number of female students taking up natural sciences. From the study, it was noted that female role models have a great impact in inspiring female students. The situation in Zimbabwe generally there are few females in the natural sciences sector. Therefore, there is great need to continue promoting more females into natural science sector through natural science girl child scholarship, donation of laptops, and employment of female natural science teachers (this exposes female students to

female role models and in turn it motivates more female students to study natural sciences). Since most of natural science subjects are practically based, from the study it was noted that there are few schools in Zimbabwe that can offer natural sciences at advanced levels as most of schools are in rural areas where there is no electricity. Some of the practicals would require electricity. For natural sciences to be offered even in rural schools there is need for rural schools to get some funding in order to buy generators and also solar system to be installed. An increase in number of schools offering natural sciences at advanced levels would contribute to an increase in the number of female students studying natural sciences.

The few female students who engage in natural sciences are motivated by their career choice which they viewed as more rewarding and the greater opportunities of getting employment worldwide as the natural science workforce is not meeting the demand. There is need also for parents and teachers should also work hard to eliminate the negative gender and cultural stereotypes in order to enhance female students' confidence about their natural science abilities. Every child deserves motivation despite his or her gender. Sjaastad (2012) recognizes the big influence that parents, teachers and friends can exert on young people for them to choose scientific careers.

Implementation of educational tours, natural science quiz competitions and mathematics Olympiad should be done by schools in order to broaden the students' insight for natural science profession. The researcher believes that it may be productive to continue exploring this theoretical perspective to support the development of our research. The next step in our research to delve extensively into the theoretical perspectives that connects the self and identity with professional choice.

Conflict of Interest Statement

The authors declare no conflicts of interests.

About the Author

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