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CULTURE, MEDIA & FILM | RESEARCH ARTICLE

Environmental factors and *STEM* career path choice intentions of junior secondary school girls in North-Central Nigeria

Mercy A. Iroaganachi^{1*}, Yemisi T. Babalola² and Deborah O. Soyemi²

Abstract: The study investigated the influence of environmental factors on *STEM* career path choice intentions among secondary school girls in North-Central Nigeria. It was motivated by the low representation of females in *STEM* fields globally and particularly in Nigeria. Survey design was adopted for the research. The population comprised of 5,433 junior secondary school girls from Federal Government Colleges in the geo-political zone. The sample size was 361 girls and multi-stage sampling technique was used for the selection. The instrument for data collection was a validated questionnaire. Data were analyzed using the descriptive statistics and binary logistics regression. Findings showed that secondary school students at the junior level have high intentions to choose *STEM* career path. Teachers, role model and parents significantly influenced secondary school girls *STEM* career path choice intentions. Therefore,

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PUBLIC INTEREST STATEMENT

A study of the influence of environmental factors on the girls' Science, Technology, Engineering and Mathematics (*STEM*) career path choice intentions is vital as it provides a better understanding of the global problem of low female representation in *STEM* fields which could only have been predicted on the career path choice intentions of secondary school girls in the past. The study revealed that secondary school students at the junior level have high intentions to choose *STEM* career path. It showed that teachers can positively influence secondary school girls *STEM* career path choice intentions by the way they teach and stimulate classroom discussions. It found that, role models and Parents influence secondary school girls *STEM* career path choice intentions. Consequently, the research made relevant recommendations for bridging the *STEM* gender gap in Nigeria thereby building and releasing the latent human resources required to sustain development and compete in the global economy.

it is recommended that secondary school management should motivate and sustain the female students' STEM career intentions of girls among others.

Subjects: Gender & Development; Sustainable Development; Education Studies; Middle School Education; Secondary Education; Early Years

Keywords: Environmental factors; Intentions; Path choice; School girls; North-Central Nigeria; STEM career

1. Background

The noticeable gender disparity in school enrolment, especially the imbalance in STEM (Science, Technology, Engineering and Mathematics) portend immediate and long-run dangers to Nigerian economic progress and sustainable development. While few studies Fatoki (2014), Ugo and Akpoghol (2016), and Mtemeri (2017) have documented general effect of low school enrolment particularly among girls in developing countries, studies that have examined the challenges inherent in career path choices of girls are very minimal especially as it relates to Nigeria (Effiom & Petters, 2019). STEM education is a teaching and learning system in which science, technology, engineering and mathematics are integrated into varied subject areas. It has the potential to increase comprehension of how things work, boost students' usage of information communication technology tools as well as introduce them to more engineering courses in precollege education (Fareo & Garkuwa, 2018). Accordingly, it is not a prerogative of boys only but depends on students' disposition to STEM subjects and careers, their intention to choose any and their choices.

The future global development in all ramifications depends largely on STEM professions (UNESCO, 2014). Iroagnanachi et al. (2017) opined that a nation's ability to produce food for its people, build new industries and develop new technologies is reliant on the scientific knowledge and skills of its people. However, concerns have been expressed since the early 1970s regarding the disparity between female and male enrollment in science classes (Wolo, 2018). These concerns have focused progressively on the consequences of the existing imbalance in universal scientific literacy and in gender equity in the pursuit of STEM. By the end of secondary school, the number of girls with the motivation and background to progress into further studies in STEM is much smaller than that of boys (Iroagnanachi et al., 2017). The UNESCO Institute for Statistics (2015) revealed that female representation is relatively 30% of the total global population in STEM while in Africa, it is less than 17% (Ekine, 2013) and in Nigeria 25% (Ojokoh et al., 2015). This indicates low representation of female participants in scientific development, and decision-making. This situation could translate to low scientific initiatives and inadequate implementation in meeting the needs and preferences of both sexes especially those of women. Addressing this challenge largely depends on the career intentions and choices that girls make today which could be determined by some predominant environmental factors, (Mtemeri, 2017 & Fatoki, 2014).

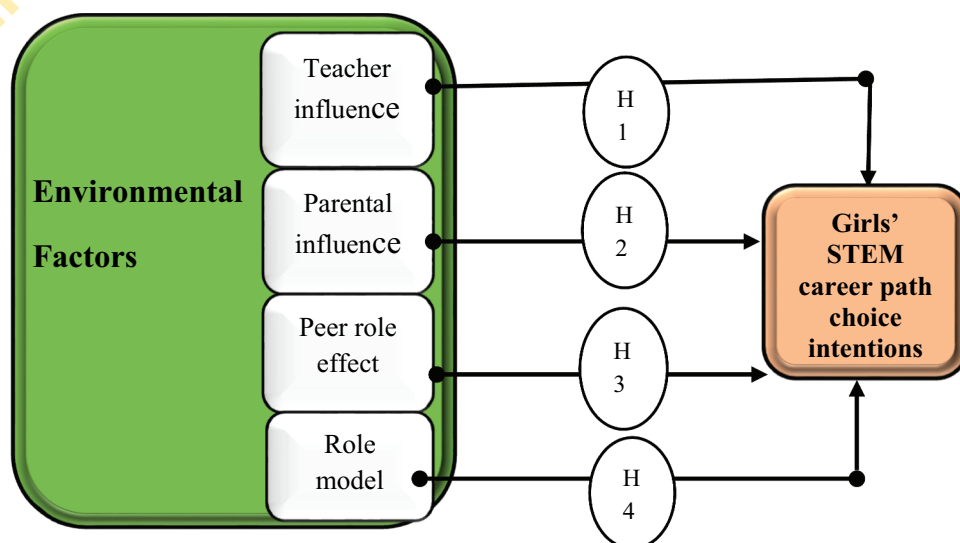
STEM education refers to a teaching and learning approach whereby science, technology, engineering, and mathematics are integrated intentionally. STEM education is typically not taught as a single course, it is often integrated into most subject areas (Reeve, 2015). This is due to the fact that it directly involves the two important subject matters with high priorities on any nation's agenda, (notably innovation and problem solving). STEM plays a vital role in modern societies with the possibility of improving lives in a number of ways and advancing the development of nations (Ekine, 2010). Thus, the need to encourage girls to choose the STEM career paths. Choosing STEM career path begins with an intention which is the willingness to choose and enrol for a set of subjects by secondary school students at the early school stages of their education such as Social Sciences, Physical Sciences and Applied Sciences, that meets the requirement for their ultimate desired profession. According to Effiom and Petters (2019) and Marcus (2017), majority of students are heavily influenced either by professions that their parents favour, impose on them or those that their educational achievement offered in making their choices (Ugo & Akpoghol, 2016). For instance, family and friends with a background in agriculture oftentimes could impact on

a student's decision to major in agriculture (Fizer, 2013). However, children are not exposed long enough to certain fields of study thus, Abdelmelek and Hanani (2017) are of the opinion that a lot of children do not get to see people working in STEM fields because it is a lot easier to picture yourself doing something that you have seen someone else do.

Also, the fact that peer influence plays a major role in determining students' career path choice intentions cannot be underestimated as several studies have revealed. Edwards and Quinter (2012) in Nigeria, Kimiti and Mwova (2012) in Kenya, Abbasi and Sarwat (2014); Shumba and Naong (2012) in South Africa and Alika (2010); Faiter and Faiter (2013) in America, established from their studies that students were influenced by their peers in different ways which is; peer advice, peer relationships, peer counselling and peer interactions. Furthermore, teaching quality, student involvement in school activities, college practices and policies coupled with learning materials that students engage with, were found to impact on career choices among boys and girls (Shumba & Naong, 2012). Students' classroom experience and interactions with teachers, peers and the curriculum have a great effect on their learning engagement in a subject (Miske, 2013). However, in science classroom settings all through Nigeria, girls are often discouraged from engaging in science subjects and activities, due to factors related to instruction and assessment based on curriculum (Ekine, 2013).

This study is premised on Social Cognitive Career Theory propounded by Lent, Brown and Hackett in 1994. The theory explains how basic academic and career interests develop. It illustrates how educational and career choices are made, and how academic and career success is obtained (Lichtenberger & Casey, 2013). Specifically, the theory states that intention to choose a career is dependent on three cognitive-person constructs which include; self-efficacy, outcome expectations, and choice goals and that these constructs interact with environmental factors to predict the decisions people make concerning their academic and vocational choices. SCCT assumptions are focused on task specific self-efficacy; therefore, Lent, Ireland, Penn, Taylor and Sappington (2017) suggest that efficacy expectation that are related to career choice should result in outcomes, such as vocational interests, choice goals, and behaviors. This theory acknowledges that estimating self-efficacy and outcome expectations do not exist in isolation; instead they are influenced by personal experiences which could be parental support, teacher encouragement, role models Beede et al. (2011), peer advice and other environmental factors that could be in the form of discrimination or support. The conceptual model of sub-variables for measuring environmental factors in this study is as presented in Figure 1.

Figure 1. Conceptual model for environmental factors and girls' STEM career path choice intentions.



There have been several initiatives and efforts such as free education and scholarship for STEM students targeted at ameliorating the issues of gender disparity in STEM fields and there has not been much success in attempting to fill a reasonable portion of jobs in STEM related fields with women (Wolo, 2018). Irrespective of these initiatives, the researchers' observation and several studies have shown that the challenge of low participation of girls in STEM career paths has not abated much. In fact, it has become a serious issue of concern and discourse that is begging for solution globally. Consequently, it is imperative to know the environmental factors that can affect STEM career path choice intentions of secondary school girls. Specifically, the study attempted to examine STEM career path choice intentions among Federal Government College girls in North-Central Nigeria and determine the influence of environmental factors on STEM career path choice intentions of girls in Federal Government Colleges in North-Central Nigeria. Female students of Federal Government Colleges in North-Central Nigeria in Junior Secondary School 2 and 3 were the focus of this study. The rationale for choosing Federal Government Colleges is that they are established, run by federal government and should serve as model colleges. North-Central Nigeria was chosen for this study because Northern Nigeria is adjudged as the most educationally disadvantaged part of the country.

2. Methods and materials

The quantitative method of research and the survey research design were adopted for this study, using a self-administered questionnaire. The total population for this study comprised a total of 5,433 junior secondary school students (girls) in Federal Government Colleges in North-Central Nigeria (Registry Offices of Federal Government Colleges in North-Central Nigeria, July, 2019). The sample size is 361 distributed between JSS2 and JSS3 girls from the North-Central geopolitical zone of Nigeria. The multi-stage sampling technique was used to determine the sample size for this study. The first stage of the multi-stage sampling technique was the deployment of simple random sampling technique to select three out of the six states in addition to FCT (Abuja) making four altogether. Having determined the states, total enumeration was used to include all Federal Government Colleges in the selected states with a population of 3,613. Afterwards, the Taro Yamane (1967) sampling formula was used to determine the sample size of 361. After which, the proportionate distribution formula was used to distribute the sample across the colleges. To determine the actual respondents, a sample frame was sought (registers of the girls in JSS2 and JSS3 classes in the schools) from each stratum (JSS2 and JSS3) in each school. Identification number was assigned to each name on the sample frame and respondents were randomly selected.

Questionnaire was employed in the collection of data for this study. The questionnaire on the influence of environmental factors was composed of items that include; teacher, parents, role models and peer factors. All the response formats of the items followed the pattern of a four Likert scale ranging from Strongly Agree (SA) = 4, Agree (A) = 3, Disagree (DA) = 2, to Strongly Disagree (SDA) = 1. Data collection was carried out by the researcher and four well briefed research assistants in the study areas. The essence of briefing the assistants was to avoid unnecessary mistakes in the administration of the questionnaire and to explain difficult areas in the questionnaire whenever the need arises. Duration of data collection for the study was one month.

The data collected were analyzed using descriptive statistics such as percentage, mean and standard deviation. The hypothesis formulated was tested using binary logistics regression statistical technique. However, since the independent variables were measured on a four point Likert-scale, they were re-coded. Specifically, the independent variable in Likert scale was re-computed into binary codes (1 and 2) for proper interpretation of the analyses outcomes. Responses under agree and strongly agree were grouped as agree while disagree and strongly disagree were merged as disagree. Thus, all responses on environmental factors were agree and disagree. The dependent variable for these hypotheses remained STEM career path choice intentions, that was captured as binary codes (Yes = 1 and No = 2). A 5% Level of significance was observed throughout. The general binary logistic model is depicted as:

Table 1. STEM career path choice intentions of respondents

I intend to choose STEM career path	Frequency	Percent
No	26	7.2
Yes	335	92.8
Total	361	100.0

Source: Authors' Fieldwork, 2019

$$Y = \text{Log} \left(\frac{P}{1-P} \right) = \alpha_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n \quad (3)$$

Where Y = Intention to choose STEM career path

α_0 = the intercept, often described as the constant. This is the expected mean value of Y when all Xs = 0.

B's = Various coefficient of various independent variables i.e. indicators of environmental factors).

while, X's are selected independent variables related to environmental factors.

3. Results

Table 1 revealed that majority (92.8%) of the respondents intend to choose STEM career paths. This finding indicates that the respondents have basic knowledge of some STEM careers which interest them and informed their intentions.

Table 2 revealed that environmental factors have no effect on girls' STEM career path choice intentions as the students disagreed with an overall mean of (2.32). However, they agreed that role models as a sub-variable, is part of the determinants of their intentions to choose STEM career path with a mean of (2.84) as well as teacher influences (mean = 2.55). Specific items that influenced respondents' intentions to choose STEM career path include: teaching styles (mean = 2.93), quality of teachers (mean = 2.89) and the way teachers generally stimulate class discussion (mean = 2.63). This implies that those teaching in Federal Government Colleges in North-Central Nigeria are efficient teachers and they positively influence respondents' STEM career path choice intentions

The results presented in Table 3 on environmental factors, reveal that all the environmental factors are positively related to intention to choose STEM career path. However, teacher influence, parental influence and role model influence are statistically significant except peer influence. Specifically, students that agreed that teacher influence plays a significant role in the choice of STEM career path are 3.225 times more likely to choose STEM career path compared to their counterpart that disagree with the statement [B = 1.171, p = 0.03, 95%CI: 0.93–11.21], while students who agree to parental influence in the choice of STEM career path are 7.553 times more likely to have the intention to choose STEM career path [B = 2.022, p < 0.05; 95%CI: 1.24–45.94], those that were influenced by their role models are 2.943 times more likely to choose STEM career path compared to their colleagues who disagreed with the statement [B = 1.079, p < 0.05; 95%CI: 1.26–6.85]. The results however indicate that the peer role has positive effect on the students' choice of STEM career path but the impression could not be statistically substantiated as the p-value is greater than 5% (sig. = 0.305). The overall summary model shows that the combination of these variables, namely: peer influence, role-model influence, teacher influence, and parental influence could exert between 12.9% and 23.3% influence on the intention to choose STEM career path among the students studied (Cox & Snell R Square = 0.129, Nagelkerke R Square = 0.233).

Table 2. Environmental factors and STEM career path choice intentions of respondents

ITEMS	Strongly Agree	Agree	Disagree	Strongly Disagree	Mean	Std.
Role-Model Influence					2.84	
I intend to choose STEM career path because I have role models in STEM professions	124(34.35)	110(30.47)	71(19.67)	56(15.51)	2.84	1.07
I intend to choose STEM career path because I want to be like a scientist, Engineer or Mathematician that I admire	124(34.35)	110(30.47)	71(19.67)	56(15.51)	2.84	1.07
Teacher Influence					2.55	
I intend to choose STEM career path because my Math teacher teaches in a clear and organized manner	139(38.50)	105(29.09)	68(18.84)	49(13.57)	2.93	1.06
The quality of teachers in my school played a huge role in influencing my intention to choose STEM career path.	125(34.63)	117(32.41)	74(20.50)	45(12.47)	2.89	1.02
I do not intend to choose STEM career path because of discouragement from my teachers.	19(5.26)	32(8.86)	155(42.94)	155(42.94)	1.76	.82
I intend to choose STEM career path because my teachers generally stimulate class discussion	84(23.27)	120(33.24)	98(27.15)	59(16.34)	2.63	1.01
Parental Influence					2.04	

(Continued)

Table 2. (Continued)

ITEMS	Strongly Agree	Agree	Disagree	Strongly Disagree	Mean	Std.
Role-Model Influence					2.84	
I intend to choose STEM career path because a job already exists for me to take up in my parents company upon my graduation from higher institution.	78(21.61)	65(18.01)	118(32.69)	100(27.70)	2.34	1.10
I intend to choose STEM career path because one of my parents or both parents are in STEM profession and want me to be in the same field.	54(14.96)	84(23.27)	127(35.18)	96(26.59)	2.27	1.01
I do not intend to choose STEM career path because from childhood I have been made to believe it is not for girls by my parents.	24(6.65)	40(11.08)	133(36.84)	164(45.43)	1.79	.89
I do not intend to choose STEM career path because of discouragement from my parents.	27(7.48)	23(6.37)	150(41.55)	161(44.60)	1.77	.87
Peer Influence					1.15	
I intend to choose STEM career path because my peers advised me to do so.	48(13.30)	71(19.67)	145(40.17)	97(26.87)	2.19	.98
I intend to choose STEM career path because my peers intend to choose same.	49(13.57)	58(16.07)	140(38.78)	114(31.58)	2.12	1.00
Overall Mean					2.32	

Source: Authors' Fieldwork, 2019
 Decision rule as adapted from Mohammed (

Table 3. Binary logistic regression illustrating the interrelationship between environmental factors and girls' STEM career path choice intentions in Federal Government Colleges in North-Central Nigeria

Environmental factors indices	B	S.E.	Wald	Sig.	Exp(B)	95% CI
Teacher influence	1.171	0.635	3.395	0.065	3.225	0.93–11.21
Disagree (RC)						
Parental influence	2.022	0.921	4.818	0.028	7.553	1.24–45.94
Disagree (RC)						
Peer role effect	0.424	0.413	1.053	0.305	1.528	0.68–3.43
Disagree (RC)						
Role_Model	1.079	0.431	6.272	0.012	2.943	1.26–6.85
Disagree (RC)						
Constant	0.897	0.973	0.851	0.356	2.453	

–2 Log likelihood = 240.557; Cox & Snell R Square = 0.129; Nagelkerke R Square = 0.233

NB: Reference category = RC = Disagree (responses)

Source: Authors' Fieldwork, 2019

4. Discussion

Response to research question one revealed that majority (92.8%) of the respondents intend to choose STEM career path. This implies that secondary school girls have interest in STEM careers. The secondary school girls' interests in STEM career path may have been informed by several environmental factors that interacted with their self-efficacy and/or outcome expectation including those found in this study. Sawar and Azmat (2013) confirmed that career path choice intentions are not made on standalone basis but are influenced by multiple factors. Lent, Brown, and Hackett (1994) and Bandura (1986) in their theories of social cognitive career theory and social cognitive theory, asserted that career choice intentions are developed by interest that are informed by "self-efficacy" Lent, Ireland, Penn, Taylor and Sappington (2017) and Sawar and Azmat (2013) "outcome expectations" Lichtenberger and Casey (2013) and their interactions with environmental factors to predict academic and vocational choices. Nevertheless, secondary school girls need to deliberately sustain their STEM career path intentions in order to actualize their desired STEM career choices. Study by (Herrera & Hurtado, 2011) discovered that career aspiration must be preserved by protecting it from any intrusion for it to be realized.

The overall mean of the descriptive data presentation on the research question two revealed that Federal Government College girls in North-Central disagreed that environmental factors had effect on their career path choice intentions. However, some indicators such as role models influence with mean 2.84 and teacher influence like teaching styles mean 2.93, quality of teachers with mean 2.89 and teacher stimulation of class discussion with mean 2.63 influenced respondents' intentions to choose STEM career path as agreed by them. The implication of this finding is that teachers can actually motivate students and arouse their interests to choose STEM career path. This finding is in agreement with those of Ekine (2010), Ekine (2013), Miske (2013) and Shumba and Naong (2012) who found that teaching quality, instruction methods, learning materials and students' classroom experience and interactions with teachers can motivate students and arouse their interests to take STEM subjects. On the other hand, Ugo and Akpoghol (2016) found that inefficiency of the teachers constitute one of the challenges to STEM programs amongst secondary school students in Benue state, Nigeria.

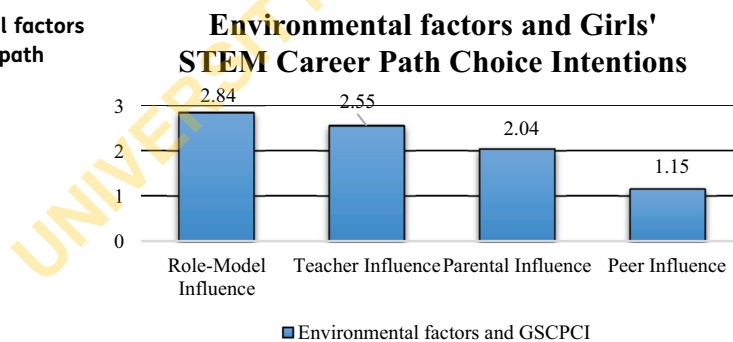
The finding on teacher influences supports and explains more the view of self-efficacy being a determinant for career path choice intentions as asserted by Lent, Ireland, Penn, Taylor and Sappington, (2017) and Sawar and Azmat (2013) and propounded by Lent, Brown, and Hackett

(1994) and Bandura (1986) in their theories of social cognitive career theory and social cognitive theory. Invariably, the more female students perform well in STEM subjects, the greater their interest will be in choosing STEM career path.

Another implication of the findings of this study is that role models can encourage the intentions to choose STEM career path. This view is supported by the findings of Beede, Tiffany, Langdon, Mckittrich, Khan and Doms' (2011) research on gender gap in STEM which found, among others, that female role models is a strong motivating factor but the society lacks them. Peers and parents were found not to have affected STEM career path choice intentions of junior secondary school girls in North-Central Nigeria as respondents disagreed to both indices. These are against findings from previous studies such as Effiom and Petters (2019), Marcus (2017), Edwards and Quinter (2012), Kimiti and Mwova (2012), and Abbasi and Sarwat (2014), Shumba and Naong (2012) and Alike (2010) and Faiter and Faiter (2013) established that students were influenced by their peers in different ways. Marcus (2017) as well as Shumba and Naong (2012) also found in their studies that teachers had significant influence on the choice of career path among secondary school students. The situation in this study could be because it is still at the level of intention and not actual choice as Amani and Mkumbo (2016) found that career intentions were highly determined by how individuals perceived their prospective careers. More so, intention is a personal disposition towards a planned behaviour.

Finding from the test of hypothesis on whether environmental factors will significantly influence STEM career path choice intentions of girls indicated that role model influence was significant on junior secondary school girls' STEM career path choice intentions (Figure 2). This implies that seeing somebody who is doing what one likes and admires is a driving force for wanting to be like that individual. Abdelmelek and Hanani (2017), Lent et al. (2017), and Bett (2013) are of the opinion that a lot of children do not get to see people working in STEM fields as it is a lot easier to picture yourself doing something that you have seen someone else do.

Figure 2. Environmental factors and girls' STEM career path choice intentions.



The result of the test of hypothesis showed that teachers had significant influence on intentions of girls to choose STEM career path. This means that teachers can gain the trust of students as well as determine the career path choices of their students. This agrees with the findings of Marcus (2017), Ekine (2013), Miske (2013) and Shumba and Naong (2012) which revealed that teaching quality and teacher classroom interaction with students influenced their choice subjects.

Furthermore, the result of this study showed that parents had significant influence on intentions of girls to choose STEM career path. This may be due to the fact that a job already exists in parents companies to be taken up upon graduation from higher institution and or any of the parents or both are in STEM profession. Ugo and Akpoghol (2016), Effiom and Petters (2019), and Marcus (2017) found from their studies that parents misguide their children in making career choices therefore they recommended that parents should desist from such acts. Also, Fizer (2013) and

Fatoki (2014) confirmed that adolescents and young adults from certain cultures that are characterized by collective decision making were more inclined to choose a career path that was consistent with the preferences of their family members.

Peers as a sub variable, did not have significant influence on girls' STEM career path choice intentions however, they were positively related. This implies that secondary school girls may trust and respect the advice of their peers and/or be controlled by peers to some extent. This is in consonance with findings from earlier studies by Mtemeri (2017), Edwards and Quinter (2012), Kimiti and Mwova (2012), and Abbasi and Sarwat (2014), Shumba and Naong (2012), Alika (2010) and Faiter and Faiter (2013). They found that peers influenced career choices amongst themselves. Also, studies by Kaaria et al. (2014), Marangu, Bururia and Njonge (2012), Chireshe (2012), Ehigbor and Akinlosotu (2016), and Egunjobi et al. (2013) revealed that peer counselors were vital to mentoring students, sharing information and supporting one another.

5. Conclusion and recommendations

The study concluded that secondary school girls at the junior level have high intentions to choose STEM career path. The examined environmental factors put together as a whole do not adequately determine the girls' STEM career path choice intentions. However, indicators of the variable like teachers, role models and parents significantly influenced secondary school girls STEM career path choice intentions. Therefore, it is recommended that; secondary school management should give incentives and or introduce programmes that will motivate and sustain the female students' STEM career intentions such as awards and recognitions to girls who excel in STEM subjects as an encouragement both to winners and others. Also, school management should expose secondary school girls to more female experts in STEM profession who are potential role models. This could be through programmes that affords girls the opportunity to interact with female STEM professionals and other senior college students thereby allowing them to develop interest and be able to study and eventually work in STEM fields. The more role models the girls know and interact with, the stronger their intentions to choose STEM career path and enrolment in STEM subjects will be. Government should formulate a policy that mandates STEM teachers to undergo capacity building and career development programmes at least once in a session as a condition for staying employed thereby enhancing their knowledge of the subjects, teaching quality and classroom management. Parents are encouraged to respect the STEM-based decisions and choices of their daughters and wards as well as support them in every way possible to achieve their career aspirations as any negative intrusion can lead to frustration. Secondary school authorities, NGOs, Career counselors and other stakeholders in the education sector are encouraged to give adequate STEM career awareness and knowledge to enhance peer influence.

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