

Bridging the Gap in Gender Parity in STEM education in Kenya: A comprehensive Literature Review

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ABSTRACT

Over several decades now, despite the efforts of the Kenya government and specialised agencies like National Gender and Equality Commission (NGEC), prior researchers have established the persistent of gaps towards attaining the international and national commitments over gender parity education. For this reason, this study aims to establish the current status of Gender parity in STEM education in Kenya, Investigation the intervention /projects/programs that are in place to bridge the gaps in gender parity in STEM education in Kenya, Analyse the gaps that exist in the intervention /projects/programs for Gender parity in particular Science Technology, Engineering, and Mathematics (STEM) subjects and in general education in Kenya. The aim is to provide recommendations to fill these gaps in form of intervention /projects/ programs for Gender parity in STEM education in Kenya.

This study adopted a systematic literature review in which articles were searched and selected from a representative of 5 Journal Articles databases namely: Journal Storage (JSTOR, Elton B. Stephens Co. (EBSCO), Francis and Tylor, Emerald, and Informs. In addition, selected reports on gender parity from world bodies and agencies were reviewed, plus other journal articles that are relevant to the Kenyan gender equality context. The findings reveal six general categories of determinants of gender parity including (1.) Labour markets factors, (2.) Family formation (3.) Culture versus nurture (including religion) (4.) Psychological elements (5.) Family background and 6.) Policies namely. Unfortunately, the findings reveal several gaps that need intervention projects/programs. Consequently, for each of the category of gaps, plausible interventions were recommended for consideration, adoption and implementation.

The findings establish the need for the following interventions: Bann Domestic labour market, Skill development for the less privileged Gils and Boys, a. Empowering girls with information, skills and support networks, Educating and mobilizing parents and community members, Enhancing the accessibility and quality of formal schooling for girls, offering economic support and incentives for girls and their families, and Fostering an enabling legal and policy framework.

1. BACKGROUND

1.1 Introduction

According to the Universal Declaration of Human Rights adopted by United Nations in 1948, Education was recognized as an international priority, and the right to education was then

enshrined by all governments globally (Didham & Ofei-Manu, 2015). The Education 2030 Agenda for Sustainable Development opened a new chapter in the long struggle towards achieving gender equality. In the Education 2030 agenda Goal+4. Aims to Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all, while Goal+5.targets to achieve gender equality and empower all women and girls (Johnston, 2016).

Its commitment to 'leave no one behind' expresses the conviction that boys and girls, men and women should benefit equally from development. It envisages a 'world in which every woman and girl enjoys full gender equality and all educational, legal, social and economic barriers to their empowerment have been removed'. 'Realizing gender parity and the empowerment of women and girls in education will make a crucial contribution to progress across all the Goals and targets. A number of preceding researchers argue that' No target in this agenda, including Education can therefore be considered met unless gender parity realized (Didham & Ofei-Manu, 2015).

Despite these efforts, declarations and aspirations by, UN, governments and nations, prior studies have established the fact that gender parity is still a challenge in many nations across the globe. For this reason, the main purpose of this comprehensive literature review is to establish the status of gender parity in STEM education in Kenya. The challenges and their causes that hinder the achievement of gender parity, the existing interventions/projects/programs and their failures or success, as well as the gaps that exist, and the plausible interventions and recommendations that can fill these gaps.

1.2 The education gender gap in history

The steep rise in female education and the continuing decline in the education gender gap have begun by the second half of the 19th century in Western Europe and the United States (US), the leading and more developed countries at the time, and are still ongoing in today's developing ones.

1.3 Facts

Prior studies post that the larger part of human history, women and girls have been undereducated relative to men (Bertocchi & Bozzano, 2019). Bertocchi and Bozzano, (2019) continue to argue that female education was mostly restricted or even neglected before 16th century. Nonetheless between the 16th and the 18th century, when literacy and reading skills started to progress amongst males across early modern Europe, education was a privilege reserved only for girls and women belonging to small elites, the nobility, the regular church, market-oriented classes, such as merchants or bankers, and professional minorities (Bertocchi & Bozzano, 2019). Nunn, (2014) establishes the same finding for Africa in the colonial period, where the location and activities of Protestant versus Catholic missionaries exerted different long-run effects on the educational attainment of females. Nunn consistently agrees with the conclusion that the Protestant church placed more importance on the education of women's than the Catholic one.

1.4 Determinants

Prior studies have established that trade and economic development, religion, and Family and kinship are among the determinants of the gender gap in education. The recent study by van der Vleuten, (2016) has articulated the influence of family systems on the gender education gap in 86 developing countries including Kenya in the years 1950–2005. The study argues that there is need to shape everyday family attitudes towards women and perceptions of their value and decisions about them. This is because family systems contribute in part to the difficulty in bridging the gap between men's and women's achievement in education (van der Vleuten, 2016). This paper argues that interventions in practices and policies in trade, economic development, religion, family and kinship are required to address the gaps that emanate from them in girls and women education.

1.5 Contemporaneous gender gaps in education

Contemporary researchers in gender parity have established that Labor markets factors, Family formation, Culture versus nurture, Psychological elements, Technological innovation, Family background, and policies are the main causes of gender gaps in education.

2. PROBLEM OVERVIEW

Previous studies on gender diversity post that only 17 women have won a Nobel Prize in physics, chemistry or medicine since Marie Curie in 1903, compared to 572 men (Wingate, 2017). Moreover, currently, only 28% of all of the world's researchers are women. This large disparity, such unfathomable inequality, is not incidental. Prior studies have established the fact that too many girls and women are deterred by discrimination, social norms, biases and expectations that influence the opportunities, quality of education they receive, and the subjects or courses they study. Girls' and women under-representation in science, technology, engineering and mathematics (STEM) education is deep rooted and puts a disadvantageous obstacle on progress towards sustainable development. This paper joins the call by a myriad of researchers that proclaim that we need to understand the drivers behind this phenomena in order to reverse these gender diversity trends (Wingate, 2017).

Recent studies have asserted that gender inequality in Kenya is one of the greatest problems of our time. Gender inequality remains entrenched in the structures, instrumentalities and relations within the family, society, and the state (Muigua, 2018). Additionally, preceding studies have posited that girls and women struggled to access higher education during the colonial era. For that reason, the challenge of tackling gender imbalances in education in post-independence emerged as a major focus for Kenya and other developing nations like South Africa (B. M. Akala, 2019). Several interventions including affirmative action have been advocated and implemented with varied degrees of success and outcome across many Nations of the earth. Affirmative action is a policy intervention that is meant to redressing inequities in areas such as education by giving preferential treatment to a group that was disenfranchised previously through gender or other characteristics. Unfortunately, prior researchers have demonstrated that “affirmative action has not brought about greater gender equity in Kenyan and South African higher education” (B. M. Akala, 2019). Several prior studies have posited that both Kenya and South Africa have embraced affirmative action in education where admission policies in both countries reflect gender quotas in varied degrees, with the main goal to increase women' participation in higher education post-

independence era. Although affirmative action has boosted women's involvement in higher education in both Kenya and South Africa, gender inequities have not been resolved wholly (Akala, 2019; Onsongo, 2009; Ministry of Education of Kenya, 2012).

Although there has been recent progress, contemporary studies have posited that women are still disadvantaged by their greater domestic labor commitments and impaired access to well-paid jobs; and, in some life-threatening cases, denied the right to live (Dilli, Carmichael, & Rijpma, 2019). Prior studies have established the close link between labor markets and gender gaps in education. For example Klasen and Lamanna, (2009) argues that gender gaps in education may automatically result in gender gaps in employment, predominantly in the formal sector, where employers will choose educated workers and consequently will not consider the applications of uneducated women. Contrarywise, if there are large impediments to girls and women employment or gender gaps in pay, it becomes normal for parents (and girls) to resolve that the education of girls is not as worthwhile, which might in turn lead to lesser demands for girls and women education and the subsequent gender gaps in education (Klasen & Lamanna, 2009). This shows that gender gaps in education and employment are closely related. Thus, it is evident that to solve the problem of gender gap in employment there is a critical need to reduce gender gap in the education of girls and women through intervention projects/programs

Several prior studies have established that *Labour Markets Factors* contribute to gender parity. This manifest in employers discriminating gender during recruitment and their practices of preferring men employees. This in turn may result to less jobs and opportunities for women. This may further cultivate the culture in society to prefer to educate boys who are likely to get jobs and opportunities compared to girls and women (Kimani & Kombo, 2010). The second category of determinants that hinder gender parity is *Family formation*. A number of recent studies have articulated how this manifests including Teenage Pregnancy, and Lack of sex education (Omari, 2016) Existing literature advocate that in some societies, *Culture* (Wamalwa, 2016) increases gender parity instead of nature girls and women in education. In some cultures, girls and women have terminology in those languages that dehumanize or humiliate or treat as inferior human beings' girls and women. Moreover there is bountiful of persistent harmful cultural practices such as early marriage, and/or female genital mutilation that add to curtail and in many cases ruin girls and women potential and equality in education (Abd-Kadir & Hardman, 2007; Kimani & Kombo, 2010). Despite several efforts to eradicate these practices, these harmful cultural practices are still persistent in Kenya and require innovative interventions to address them(USAID, 2017; Wamalwa, 2016; Guiso, Monte, Sapienza, & Zingales, 2008a).

The fourth category of determinants of gender equality is *Psychological elements* in the school and out of school environment for girls and women. Four predominant factors have been identified in the literature. These are (1) Bullying in schools (Ndeti et al., 2007), (2) Sexual harassment (Ruto Jerop Sara, 2009), (3) Violence against Girls (Masson, Benoudji, Reyes, & Bernard, 2018), and (4) insecure learning environments (Ministry of Education, 2008). Despite many interventions, both in school and out of school environments have increased in being insecure particularly for the girl child in all levels. For example a recent study has posited that girls' education is under attack. (Adhami, Chenelle, Freeman, & Gulino, 2018) and called for

interventions in form of legislation. Unfortunately, legislations alone may not achieve the required level of girl's education and safety. *Family background* is a major determinant of gender parity. The literature has identified six variables in this category that need interventions namely: (1) Poverty, (2) high cost of education, (3) the burden of domestic and household chores, (4) the burden of nursing sick family members, (5) the death of a parent, (6) distance, and (7) Religion. (Adhami et al., 2018; Kimani & Kombo, 2010; A. Kibui et al., 2015; A. W. Kibui, 2014).

Policy is a major category among the determinants that contribute to gender parity. Unfortunately, the government has many and good educational policies that suffer poor implementation. To this end, a number of prior studies have questioned this unfortunate phenomenon. They complain that it is now over five decades after independence, yet the “majority of Kenyan children do not receive quality education and live with limited economic and social opportunities” (Wasonga, 2013). Wasonga (2013) continues to wonder “why have educational policies not worked as intended?” This means that there is a huge gap to advice policy makers on what works. However, such advice need be based on empirical evidence for data driven decision and policy making. Consequently, this paper illustrates the above determinants of highlighting the interventions that have been tried with various degrees of success or complete failure, gaps, and more importantly make recommendations on plausible intervention projects/programs to address gender parity.

3. RESEARCH QUESTIONS

Previous studies on gender diversity in education interventions, failures and successes as well as challenges in Kenya can be used to guide future studies and plausible interventions and solutions. Therefore, systematic reviews are crucial to present the current situation and to shed light on future studies, interventions, projects and programs to address gender diversity in education. Reviewing previous studies assists researchers to make decisions on issues such as topic, method, sampling, target communities or groups, interventions that have failed and those with a measure of success, and possible interventions, projects and programs with high likely hood of great impact.

It is possible to find many systematic reviews in literature on in education (Tan, Muskat, & Zehrer, 2016; Doblhammer, Hoffmann, Muth, Westphal, & Kruse, 2009; Jasper, Le, & Bartram, 2012; Nesje & Ruud, 2018) However, there are only a few systematic reviews that examined gender diversity in education interventions. While some of these limited number of systematic reviews only investigated the articles in specific journals (Tan et al., 2016; Doblhammer et al., 2009), some others examined the articles that address a specific issue. It is observed in these systematic reviews that they usually focus on reporting the implemented interventions of one aspect of girls and women, and many of them the youth. However, more comprehensive reviews are required to identify trends in interventions in gender diversity studies. This study aimed to bridge the existing gap in literature by analyzing all gender diversity gaps and intervention related studies whose focus is girls and women in Kenya, these were obtained in various Emerald, IEEE, JSTOR, Online Willey, Taylor & Francis. We constructed several research questions based on the gaps in the existing literature. These are as follows:

1. What's is the status of Gender parity in education in Kenya

2. What intervention /projects/programs are in place to bridge the gaps in gender parity in STEM education in Kenya.
3. What gaps exist in the intervention /projects/programs for Gender parity education in Kenya
4. What recommendations to fill these gaps in form of intervention /projects/programs for Gender parity in STEM education in Kenya

4. LITERATURE REVIEW

RQ1: What's is the status of Gender parity in STEM education in Kenya

Recent evidence from The Global Gender Gap Index 2020 by World Economic Forum rankings suggests that Kenya is ranked at 109 out of 162 countries (World Economic Forum (WEF), 2020). Moreover, in the same report, it is established that this status is a decline of -33. compared to the ranking in 2018. The past three decades has seen the rapid development of girl's enrollment un various levels of education in Kenya. For example, the review of major obstacles to women's participation in higher education in Kenya by Sifuna, (2006) established a six of the problems related to the education of girls in Kenya. These include: The direct cost of schooling, Domestic labour market, Social customs, Pregnancy and sexual harassment, Distance of schools, Classroom culture (Sifuna, 2006). Despite the fact that the government and other players in the education and gender sector have implemented various interventions with varying degree of success including Policy (Wasonga, 2013), recent evidence suggests that the problems related to gender parity are still persistent in Kenya today. Indeed the six problems that were identified by Chege and Sifuna, (2006). agree with the six gaps identified by Bertocchi and Bozzano, (2019) namely: Labor markets factors , Family formation, Culture versus nurture , Psychological elements , Technological innovation, and Family background. Moreover many countries remain far from achieving gender equality in the classroom (Evans, Akmal, & Jakiela, 2020)

4.1.1 Labor markets factors

The labor market factors that affect girls and women education can be categorized into three: Domestic labor market (Sifuna, 2006; Mungai, 2012) . Discrimination by employers, and low job opportunities for women as a result of gender preference (Kimani & Kombo, 2010). Over the last three decades, there has been a rapid rate of growth in urbanization, which in turn increase the demand for domestic labor in urban areas Prior studies have established that rural households that are marginalized and usually deprived of resources take this as opportunity by sending their daughters into the domestic labor market in pursuit of for a steady cash income (Mungai, 2012). This phenomenon has been accelerated by collapse of many rural based economic activities such as textile industry and hence cotton farming, and poor returns from those that are remaining like coffee and tea that hardly benefit the rural farmers due to cartels and brokers as well as inefficient management and high prices of farm inputs. This leads to increased poverty, and inability to cope with partial costs such as school uniform required to keep the girls in school. In turn this then lures girls away from school (Mungai, 2012) While boys put in an average of 19 hours per week, Girls work an average of more than 25 hours per

week. The above demonstrates that girls are expected to remain performing their customarily designated roles of cooking and food preparation, cleaning, babysitting, and farming even as well as attend school. On the other hand, Boys' roles within the household economy are restricted to looking after animals or cultivating in the farm (Mungai, 2012; American et al., 2017). The above happenings call for intervention to address the gaps.

4.1.2 Family formation

Teen pregnancy is keeping girls out of school in Kenya

Existing literature confirms that parents are fearful that when the girls go to school they will forget the cultural values and engage in premarital sex that will intern interfere with their leaning potential, and possibly lead to teenage pregnancy and possibly contract deceases like HIV (Mungai, 2012). Mungai (2012) further posts that girls who are financially disadvantaged are exploited sexually by the rich men in exchange for money. To make the matter worse, the lack of educational policies to allow the pregnant girls continue in school or even permit their re-entry after the birth of the baby makes the parents more afraid in taking girls to school. Contemporary studies show that for older girls entering schools, their adulthood makes them vulnerable to sexual exploitation and pregnancy (Omari, 2016). Occurrences of violence against school girls, including sexual violence, help to strengthen the parents' fears about their daughters' safety. Unfortunately, due to changing society values one girls and women, violent against girls is prevalent both outside and inside schools. Due to the increase in recent times, research researchers have been making bold statement that schools' girls education is under attack (Adhami et al., 2018)

4.1.3 Culture versus nurture

Let us now focus to a specific research line that has focused on the determinants of the gender gap in schooling accomplishment, and in particular in mathematics' scores and in general STEM subjects, Using PISA data, a cross-country link has been revealed between measures of women's emancipation and the gender gap in mathematic scores which tend to favor boys. (Bertocchi & Bozzano, 2019) Indeed the results show that the performance of girls is closer to and sometimes even better than that of boys in those nations where social, cultural and economic conditions are more advantageous to women (Guiso et al., 2008a).

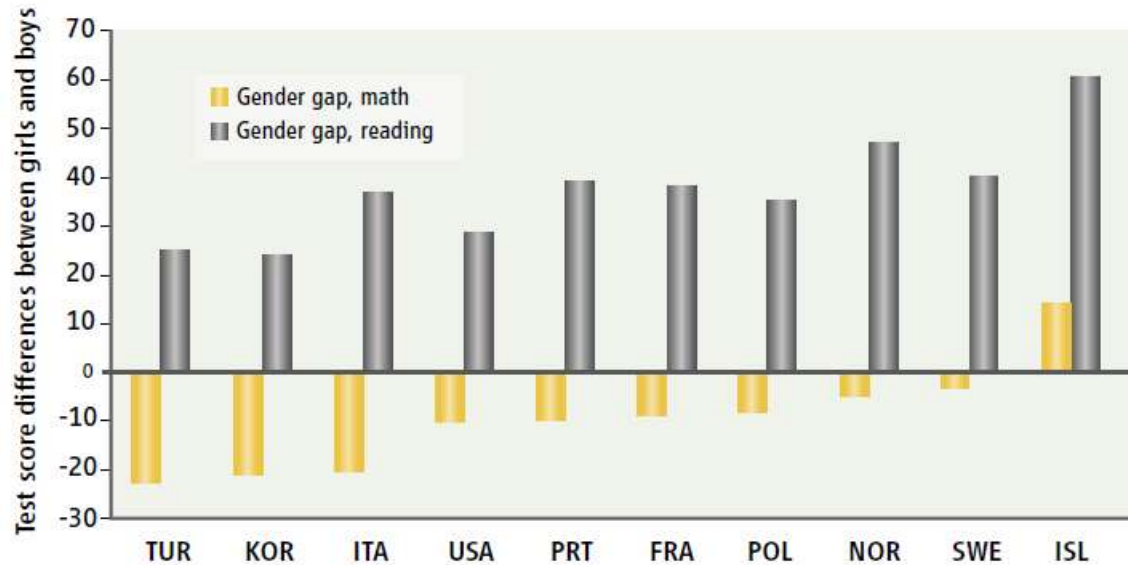


Figure 1: Test score differences between girls and boys for Mathematics and Reading Source (Guiso, Monte, Sapienza, & Zingales, 2008b)

Previous researchers have established that Math and reading gender gaps exist and are persistent and have a strong link to culture. In countries with more gender-equal cultures, the mathematics gender gap vanishes and the reading gender gap becomes greater. Gender gaps in reading (gray) and mathematics (yellow) are calculated as the difference between the average boys' score and the average girls' score (Guiso et al., 2008b). Although Kenya is not in this study, a subset of countries is shown in Figure 1. Prior studies have established, that in several countries, usually girls perform poorly than boys in mathematics. Additionally, in all nations, girls perform higher than boys in reading. The gender gap in mathematics and reading relates with country measures of gender status within the culture, one of which measures is the Women's Emancipation Index (GGI) (Guiso et al., 2008b). Larger values of GGI point to a better average position of women in society. Besides USA, the countries are abbreviated as their first three letters, except for, ISL, Iceland and PRT, Portugal.

In Kenya, prior studies have established that cultural practice of son preference may contribute to denial of girls' access to education and curtail their opportunities in life. It may lead to early marriage and the onset of childbearing. (Njogu & Orchardson-mazrui, 1973). Based on the preceding predicaments, preceding researchers have called for interventions to address the gaps. In particular they have argued that it necessary to adopt temporary special measures that would fast-track equality between the genders; such as Affirmative Action programs. Additionally, there is need for interventions for the modification of social and cultural patterns in order to achieve the elimination of prejudices and practices against women ought to be undertaken (USAID, 2017).

4.1.4 Psychological elements

Existing literature confirms that parents are fearful that when the girls go to school they will forget the cultural values and engage in premarital sex that will intern interfere with their leaning

potential, and possibly lead to teenage pregnancy and possibly contract diseases like HIV (Mungai, 2012). Mungai (2012) further posts that girls who are financially disadvantaged are exploited sexually by the rich men in exchange for money. To make the matter worse, the lack of educational policies to allow the pregnant girls continue in school or even permit their re-entry after the birth of the baby makes the parents more afraid in taking girls to school. Contemporary studies show that for older girls entering schools, their adulthood makes them vulnerable to sexual exploitation and pregnancy (Omari, 2016). Occurrences of violence against school girls, including sexual violence, help to strengthen the parents' fears about their daughters' safety. Unfortunately, due to changing society values on girls and women, violence against girls is prevalent both outside and inside schools. Due to their increase in recent times, researchers have been making bold statements that schools' girls' education is under attack, and need interventions to rescue them (Adhami et al., 2018).

4.1.5 Family background/Poverty

Studies of gender diversity show the importance of poverty and associated family background in affecting the education of women and girls. Kimani and Kombo, (2010) assistant in Kenya family background and poverty makes itself visible in the forms of disadvantages in life such as illiteracy, hunger, malnutrition, lack of shelter, and failure to access essential social services such as lack of clean water or no water at all, basic education, health, and sanitation. This is established and observed in the Republic of Kenya Sessional Paper No.3 of 1999 and Kenya Vision 2030, the current Blue-Print that is guiding the Government Development Agenda, up to 2030 (GOK, 2007). Majority of the Kenyan poor are women as few of them access educational opportunities due to the low value placed on the girl child, as compared to the boy. Based on the traditional beliefs and practices, women have had less or no ownership, access and control to family assets and resources, as compared to their male counterparts. In this respect, in the incidences of deprivation through poverty, they are more vulnerable.

RQ2: What intervention /projects/programs are in place to bridge the gaps in gender parity in STEM education in Kenya.

4.2.1 Labor markets Interventions

One of the most notable evident youth intervention the last several decades is the government's establishment of the National Youth Service in 1964 (Kempe, 2012). Kempe (2012) continues to assert that engaging the youth population fully in Kenya is no longer a choice but an authoritative in the development process. Researchers have therefore advocated the need for, and strategies for transforming the youth through empowerment, education, and employment (Kempe, 2012). Among the recent interventions were the creation of the Ministry of State for Youth Affairs (MOYA) in December 2005 to address youth concerns in the country. This was a knee-jack reaction after the realisation that the government may not achieve the Millennium Development Goals without adequately dealing with the many socio-economic challenges facing the Kenyan

youth (Kempe, 2012). A year later in 2006, the government established its first Kenya National Youth Policy (KNYP). The KNYP, defined the youth as individuals living in Kenya in the age bracket of 15 – 30 years, contained government vision as a society where youth have an equal opportunity as other citizens to manifest their fullest potential, productively participating in social, political, economic, cultural and religious life without fear or favor, that has been reviewed recently (Republic of Kenya, 2019).

Over the last one decade, the government has tried a number of interventions including: National Youth Council (NYC), Department of Sports, in the Ministry of Gender, Sports, Culture and Social Services, to the MOYA creating the Ministry of Youth Affairs and Sports (MOYAS) , Youth Empowerment Development Fund(YEDF) Kazi Kwa Vijana (KKV) ('Jobs or Work for Youth') (Kempe, 2012). Nonetheless, there have been a considerable number of surveys studies that have been undertaken with reports and published articles that consistently conclude that there are persistent risks and challenges faced by Kenyan youth, which include: marginalisation, unemployment, harassment by the police, and of major concern the impediments in accessing important facilities and services such as education and healthcare (Kempe, 2012). The preceding clearly demonstrates that the Kenyan government has been progressing and executing several policy frameworks and programmes to tackle the challenges confronting the Kenyan youth. However, the government itself has also recognised that some of its youth initiatives have encountered their own share of implementation problems including corruption. Indeed others have criticised the failure and lack of meaningful realization to many of these interventions For example(Sindabi, 2011) is of the view that 'The Kazi Kwa Vijana project initiated to create jobs for the youth seems like a political gimmick to hoodwink Kenyans the government is concerned about the plight of the youths'. Sindabi (2011) continues to assert that 'it was alleged some officials demanded bribes, tribalism and nepotism was rife. Only road construction jobs were available and favoured men'. Another writer, Muthee, was emphatic that:

Kenya's KKV and YEDF fall short. Their activities overlap, and their objectives are too broad, which makes them unachievable within a reasonable time-frame. They are also constrained by heavy government control . . . As a consequence, the programs are burdened by politics rather than professionalism. (Muthee, 2010)

Thus, existing literature, advocates for interventions and , strategies for engaging the youth through empowerment, education, and employment (Kempe, 2012)

4.2.2 Family formation Interventions

Over the years, researchers and educators have established that early pregnancy is a major obstacle to young girls gaining an education across Africa (Omari, 2016). They further argue that Teenage pregnancy has not only remained a major health and social concern because it's highly associated with high maternal and child morbidity and mortality, but also in Kenya, it is an all rounded issue as it directly affects the present and future socio-economic welfare of girls and women (Omari, 2016). Prior studies have asserted that childbearing throughout the teenage years

affects girls and women in educational achievement, as young girls who become teenage mothers have a very high probability of curtailing their education (Omari, 2016).

The scale of the problem is evident and rampant in a number of counties including, Kilifi, Homa Bay, Kajiando, Narok, Vihiga, and Kakamega. Recent studies assert that Kilifi and Homa Bay Counties in the former Coast and Nyanza Provinces of Kenya respectively experience high inadvertent teenage pregnancy rates. Although there is a policy that allows teenage mothers to return to school, both areas have a high female school dropout rate (Omari, 2016). Past studies in the counties have emphasized three main impediments: (1) Teenage mothers, their parents, and communities being unaware of the rights of teen mothers to return to school (1) School teachers and staff lacking clear understanding on the re-entry policy, , and (3) Relevant ministries of Education ignoring monitoring of the school re-entry of teen mothers (Omari, 2016).

In Homa Bay County, 33.3 % of 15- to 19-year-old girls are pregnant or have given birth, well above the national average of 18 percent, according to the 2014 Kenya Demographic Health Survey. Kilifi County has rate of 21.8% (Kenya National Bureau of Statistics (KNBS), 2014). Other researchers assert that child marriage stands at 47.4%. They further allude that cultural practices such as funerals and village dances are largely to blame for the rising teenage pregnancies. This is because such festivities lure a large number of unsupervised children who are most probable engage in risky behaviors that seems to be tolerated by culture (Omari, 2016).

The study by Malhotra, Warner, McGonagle, and Lee-Rife, (2011) did a comprehensive literature review of 150 plausible intervention projects from websites and published materials. However, on 23 of these documented an attempt to measure change in child marriage-related behaviours, knowledge, or attitudes among relevant stakeholders. These programs were implemented between 1973 and 2009, with several of the programs continuing through the present, and evaluations were published between 1991 and 2010. The study by (Malhotra et al., 2011) suggests a significant increase in the number of interventions targeting child marriage during the last decade. Majority of these interventions work directly with girls, offering them opportunities to obtain TRAINING s and education. Further, most interventions engage with families and community members and attempt to change underlying social norms that perpetuate the practice of child marriage. Lastly, many of the e interventions also offer economic incentives to parents to promote education and healthy behaviours as well as prevent child marriage.

The researchers argue that increased resources are dedicated to preventing child marriage. More importantly the interest in learning the impact and outcomes of these interventions has also increased. Despite the fact that 23 is not a large number, to weed out any possible "positive bias" in the documentation and publication the evaluations, the conclusions of (Malhotra et al., 2011) on the worthy noting since the unsuccessful programs are less likely to be documented and published. Prior studies post that programs have deployed a set of five core strategies to prevent child marriage:

- a. Empowering girls with information, skills and support networks
- b. Educating and mobilizing parents and community members
- c. Enhancing the accessibility and quality of formal schooling for girls

- d. Offering economic support and incentives for girls and their families
- e. Fostering an enabling legal and policy framework (Malhotra et al., 2011)

4.2.3 Psychological elements Interventions

Despite the government having a National Guidelines on Management of Sexual Violence in Kenya, Sexual violence has become a pandemic

Prior studies post that sexual abuse is rampant in Kenya and permeates all sectors of society. Sexual abuse takes many forms and includes harassment, unwanted touching and rape.

The last decade or more has shown that there is a pandemic of sexual violence and harassment especially in Kenyan secondary schools that causes major concern for students, parents and school authorities. The main offenders are groups of male pupils who prey on female students, abuse them verbally, harass and beat as well as raping them. That has been the result of a high-level lack of discipline in educational institutions, especially secondary schools, as gauged by the amount of student unrest in schools frequently reported in the local press. Cases of unrest and violence involve girls' schools alone are not quite as common. The most outrageous case involving girls was in July 1991 at the St. Kizito Mixed Secondary School in Tigania of the then Meru District, where 71 girls were raped and 19 died after being attacked by their male colleagues. This was followed by a spate of violence and rape cases in some schools in many parts of the country.

Most studies in the field of gender parity have asserted that Sexual violence in Kenya can begin from a young age. US-AID notes in the 2008 Kenya Demographic and Health survey that 12% of women aged 15-49 state that their first sexual encounter was forced. Furthermore, UN-Habit stated that out of sixty-six women they interviewed who had admitted to having been sexually abused eleven women reported that they had been abused as children. Overall, two thirds of these women were abused by somebody they knew: 36% by a family member and 27% by a neighbor. It was noted that women who experience sexual abuse as children are more likely to suffer from all forms of abuse when they reach adulthood

4.2.4 Policies Interventions

According to Wango, Musomi, and Akinyi, (2012) Gender equity in education entails the four sections as outlined on the realignment of the education sector to the Constitution of Kenya. These are: **The Bill of Rights**: Chapter 4 of the Constitution embodies the Bill of Rights and affirms the right of all Kenyans to education; every child has a right to free and compulsory education. State has a fundamental responsibility to observe, respect, protect, promote and fulfil the rights outlined in the Bill of Rights, Devolution. There is devolution and decentralization of powers to the Counties, yet the values and quality of education must be upheld, **Resource allocation**: This includes recruitment procedures and the qualification framework, as well as enhanced public partner relationships, and **Organization of education**: Overall policy and planning, standards and regulations, education management and information systems will require to be enhanced (Wango et al., 2012), Additionally, studies have identified corruption as a hindrance to gender equity not only because it affects economic growth and discourages foreign investment, but also because it diverts public resources from investments in infrastructure that are crucial strategic elements for poverty alleviation. Moreover, it negatively affects access to resources, particularly for the poor and marginalized who are unable to access, food, water, shelter, health services, and education. This is because such services such as education end up having prohibitive fees (Government of

Kenya (GoK), 2014) Despite fact that the government and other players initiatives to addressed some the challenges that hinder human rights in general, and specifically gender equity in education, the challenges are still persistent and some like poverty and corruption raising to alarming or pandemic levels (Hope, 2013)The questions why have these interventions failed? Recent studies have established the fact that although Kenya has put in place legal frameworks, several institutional initiatives and other strategies to attempt to control corruption, many of these measures exist primarily on paper and are not being used to their full potential (Hope, 2014). To wonder then current researchers point out that even in specific policies in education relating to gender equity such as affirmative action and -university admissions and quotas policies and interventions have not yielded the anticipated results (B. M. Akala, 2019).

Although the evidence gathered from this review points to a pervasive reduction of gender inequalities in education, prior studies reveal observable discriminatory gaps against girls and women persist, in all levels of education, in the choice of the fields of study, which in turn result to life-long fatal consequences for their occupational careers and eventual earning profiles (Bertocchi & Bozzano, 2019)

RQ3: What gaps exist in the intervention /projects/programs for Gender parity in STEM education in Kenya

4.3.1 Labor markets factors

International Labor Organization (ILO) Job Creation and Capacity Building Intervention in Kenya is innovative because, in addition to technical skills provision, training also includes cross-cutting social issues. It accomplishes this by assimilating components on workers' rights, rights-based planning, gender mainstreaming, as well as participatory approaches and HIV/AIDS prevention and coping mechanisms (ILO, 2011). However, the number of unemployed youths has been increasing year after year. Figure 3 shows Kenya youth unemployment statistics for Age group 15-24 years for the last 10 years using ILO estimates (Plechere, 2020). Unfortunately, these figures will be more than double if the ages 25-35 was include as part of the youth group in the unemployment category. Nevertheless, from Figure 2, it is evidence that youth employment remains a challenge that needs well thought interventions.

Kenya: Youth unemployment rate from 1999 to 2019

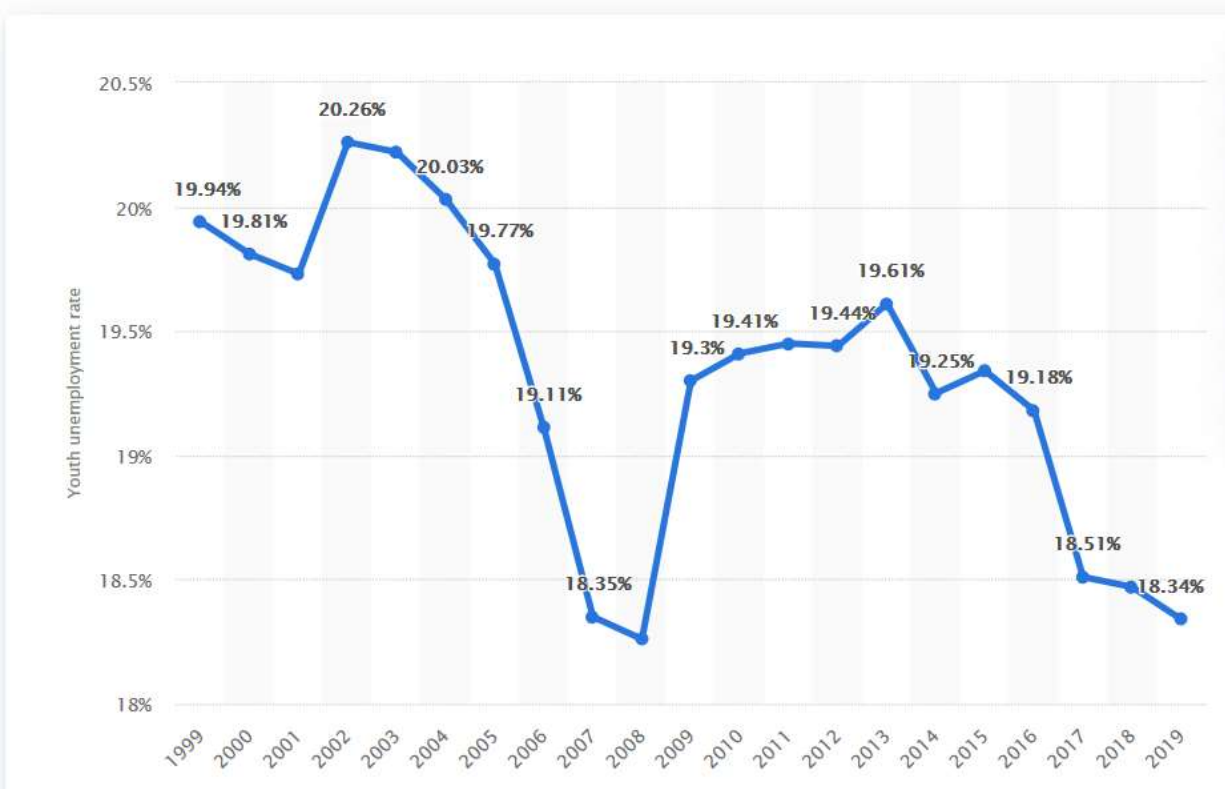


Figure 2: Kenya youth unemployment rate from 199-2019

Among the recent interventions for your employment include Kenya Youth Employment Opportunities Project which (KYEOP) that provides job specific training to the youth by (1) attending 1 month Life Skills Training and Core Business Skills Training, (2) Attend 2 months Formal Skills Training followed by 3 months internship OR (3) Join a master craftsman for 5 month Apprenticeship (KYEOP, 2019). This intervention only covers 16 counties and hence there is exiting gap in the other 29 counties. Other researchers have identified the following gaps as key research and policy priorities.

- **Employment statistics.** No reliable, up-to-date information exists on youth unemployment and underemployment. Indeed, underemployment is not recognised in official statistics. While currently the next version of the KIHBS is in progress, 15 reliable and progressively available youth (un)employment data on county and sectoral level would create the groundwork for any future evidence-based interventions and programming. Such surveys should also accommodate gender and rural/urban as key dimensions.
- **Labour market and skills assessments.** Existing labour market assessments are either out-of-date, or targeted to a specific sub-sector or region. A national labour market assessment, and skills inventory is needed to better understand the skills mismatch

described by researchers and employers, to allow for the development of policies to address this. In this regard, the gap between aspirations and actual labour market opportunities deserves particular attention, to provide youth with programmes that cater to their interests to at least some extent.

- **Sectoral case studies and assessments.** The ICT sector has been flagged as a high potential sector, both in and of itself and as a potential multiplier for other sectors. Further research is required to measure the real impact ICT is having on young entrepreneurs, and how to increase this impact, particularly among marginalised communities such as poor rural youth. In this regard, also Kenya's uprising (non-tech) creative scene should receive further attention, as creative jobs, e.g. in advertisement and in the cultural sector, become more and more attractive and lucrative. Additional case studies into the current realities and future opportunities for youth employment within sectors such as agriculture, tourism, the transport industry and the services industry more broadly, which have been flagged in this report as of particular relevance to youth.
- **Gender-sensitive assessments.** The specific understanding of the vulnerabilities faced by young women in the employment market in Kenya is limited. Further research addressing vulnerabilities faced by young people should take into account the role of gender. In addition, the vulnerabilities of and challenges faced by male youth should be considered and further investigated as well, to allow for the design of gender-sensitive approaches. (Omolo, 2018).

From the proceeding, it is evidence that huge gaps exist that demand for interventions that address the existing youth unemployment challenge. Like KYEOP, formal and informal skills training may be a good beginning.

4.3.2 Family formation

The 2010 Constitution of Kenya (Article 53) recognizes the need for all children to be protected from abuse, neglect, harmful cultural practices, all forms of violence, inhumane treatment and punishment, and hazardous or exploitative labor (UNICEF, 2015). It affirms that children have basic rights, including the right to education, nutrition, shelter, health care and parental care. These provisions are aligned with those cited in both the Convention on the Rights of the Child and the Africa Charter on the Rights and Welfare of the Child, to which Kenya is a signatory. Ensuring. However, prior studies have asserted that due to the widespread variations in geography, socioeconomic structures, and culture, there is a myriad of the common opportunities and challenges that have affected in general African families and in particular the African child in the last 25 years since the International Year of the Family in 1994 (Bigombe & Khadiagala, 2004 ; Spence, 2019).

Contemporary studies have established that families have changed over the past thirty years. This chapter provides an overview of the changes in family formation, household structure, work-life balance, and child well-being (Arnot, 1975; UNICEF, 2014). It is also reported that young men and women are getting married, or raise families without being officially married, at increasingly younger age. One of the reasons cited is the rising cost of living and the economic value of women. The bride price, which the groom has to pay for the bride, is getting prohibitive. Early

marriage means early realization of economic value of a daughter and parents who are struggling to raise many children may choose to marry their adolescent daughters earlier than they would have in different circumstances. The reason for the crisis within the family is largely attributed to new pressure caused by the epidemic. Of course, there are other factors like war, displacement of people, break-up of families, rape, death, and poverty that all contribute to the erosion of traditional courtship, marriage, and erosion of social fabric as a whole.

Research shows that children living with two biological parents outperform those raised in other family structures. A growing number of children do not live with two biological parents in sub-Saharan Africa, but few studies have examined the consequences. In this article, data from the African Population and Health Research Center collected in the slums of Nairobi are fitted to a logistic regression model to test the hypothesis that two-parent families are most favorable to schooling outcomes in Kenya. After controlling for socioeconomic variables, the effect of family structure on educational attainment of children persists (Abuya, Mutisya, Onsomu, Ngware, & Oketch, 2019). Consequently, gaps in family structure that result in family structure need interventions to address them.

A recent study on Sexuality Education Policies and Their Implementation in Kenya identified and summarized the following Gaps:

- a) Sexuality education is a key component in a multifaceted approach to address the high need for sexual and reproductive health information and services among adolescents
- b) There is support for sexuality education from the Kenyan government, but education-sector policies have largely promoted an abstinence-only approach, which has resulted in a lack of comprehensiveness in the range of topics offered in the curricula
- c) There is strong support for teaching sexuality education among principals, teachers and students alike, but the topics integrated into compulsory and examinable subjects are limited in scope, and there is little incentive for teachers and students to prioritize them.
- d) Nearly half (46%) of students were exposed to at least one topic in five key categories related to sexuality education, but only 2% of students reported learning about all of the topics that constitute a comprehensive program as defined by international standards.
- e) Some messages conveyed to students were reportedly fear-inducing and judgmental or focused on abstinence, emphasizing that sex is dangerous and immoral for young people.
- f) Students wanted more information on contraceptive methods—including how to use and where to access them—and requested more participatory teaching methods.
- g) Teachers face significant challenges in the classroom, ranging from lack of time, materials or resources to perceived community opposition, their own discomfort, and lack of knowledge or training on the topics. The improvement, systematizing and scaling up of teacher training are essential to ensure that sexuality education is delivered accurately, appropriately and effectively. and
- h) Coordinated efforts between the government and civil society organizations are urgently needed to develop and implement a comprehensive and age-appropriate sexuality education program in Kenya that is based on internationally recognized standards and the latest evidence on what constitutes a successful program (Awusabo-Asare, Doku, Kumi-Kyereme, & Esia-Donkoh, 2017).

A recent study shows that Sexuality Education Programs in Kenyan Schools Are Failing Students, Falling Short of International Standards and that Young Kenyans Misinformed About Sex and Sexuality (Awusabo-Asare et al., 2017). The report continues to assert that one in four Kenyan secondary school students in Homa Bay, Mombasa and Nairobi counties think that using a condom during sexual activity is a sign of mistrust, according to the results of a recent study on sexuality education conducted in 78 secondary schools by the African Population and Health Research Center (APHRC) in conjunction with the Guttmacher Institute.

Further, a third of female students and more than half of male students also said that when a girl says no to sex, more often than not, she really means yes. At the same time, nearly half of female and 70% of male students believed that “protected and consensual sex with someone you love is a good thing. It is evidence from these intrinsic contradictions in the responses from nearly 2,500 Kenyan students demonstrate that there is a definite lack of understanding and awareness about sexuality, sexual and reproductive rights, consent and how to best protect oneself against sexually transmitted infection or unplanned pregnancy. This paper argues that the lead author of society has a responsibility to the young people of Kenya to provide them with the best possible information about sexuality and sexual behaviour so that they can make informed, un risky and empowered choices (Awusabo-Asare et al., 2017). Consequently, it is necessary and urgent to design and implement interventions projects and programs to address these identified gaps.

4.3.3 Psychological elements

Prior studies have identified the following school-based issues which need to be addressed : **Gender stereotypes**, i. e. challenging stereotyping such as girls being unable to benefit from secondary education or less to succeed in mathematics and science, **Sexual violence**, abuse and harassment-raising awareness of these issues and using teachers to raise awareness of learners, **Ideologies** underlying the curriculum and school textbooks, **Curriculum choices**—e.g. inspiring girls to take science, mathematics, and technology subjects, **Teaching styles**, including differential attention paid to boys and girls, and **School organization and discipline**—making schools more girl-friendly (Sifuna, 2006).

4.3.4 Family background

In the National Poverty Eradication Plan, 1999 - 2015, the Kenya Government has learnt some lessons from previous poverty reduction initiatives, some of which include, recurring inability to implement remedies prescribed for diagnosed problems and their causes and a weak understanding of the real nature of poverty (Kimani & Kombo, 2010). Although some prior studies posit that Women are an important force in poverty alleviation (Omiti, Owino, Otieno W. and, & Odundo P., 2002). More recent studies have established that there are policy gaps between broad national plans, frameworks, routine sector actions and projects which in turn contribute to low levels of policy implementation; misappropriation of funds and the diversion of benefits away from the poor, among other things that directly or indirectly contribute to gender parity in education (Kimani & Kombo, 2010).

Since gender mainstreaming was not identified as one of the lessons learnt by the government, it means that the role of women in poverty reduction and creation of wealth were not recognized as important ventures in poverty reduction interventions. As such, gender as a variable in the planning process has not been identified and used in designing economic reforms and investment programmer. Yet this is important, given the existing gender disparities in the access to job opportunities, education, training, health services and control of resources in this country (Kimani & Kombo, 2010). Prior studies have asserted that gender issues in Kenyan secondary schools are commonly profoundly entrenched in socio-cultural norms (Sifuna, 2006). To change the unbalanced access to secondary schools participation and performance necessitates action to address both in-school and also non-school factors (Sifuna, 2006). The non-school issues relate to sociocultural norms. Consequently, interventions that address the gaps in existing poverty reduction interventions are needed.

4.3.6 Policies

In the recent past, the Kenyan parliament has passed enabling legislative frameworks that give implementation impetus to the Constitution. These include: -(a) Marriage Act (No. 4 of 2014), (b) Protection Against Domestic Violence Act (No. 21 of 2015), (c) Basic Education Act, (d) Matrimonial Property Act (No. 49 of 2013) (e) Micro and Small Enterprises Act (No. 55 of 2012), (f) Employment and Labor Relations Court Act, (g) Treaty making Ratification Act 2012, (h) The prohibition of female Genital Mutilation Act 2011, (i) Counter Trafficking in Persons Act 2010, (j) Sexual offences Act 2006, (k) Citizenship and Immigration Act, 2011, (l) Law of Succession Act 2012, (m) National Gender and Equality Act 2011 (Lichuma, 2017)

Further, to be able to implement these frameworks the government has put in place the State Department of Gender under the Ministry of public service, Youth and Gender. Additionally, there are special catalytic interventions funds dedicated to women, persons with disabilities and the youth for development programmes. These are: -

- a) **Women Enterprise Fund (WEF)** that provides micro-finance credit and other financial support for women;
- b) **The Youth Enterprise Development Fund (YEDF)** that provides credit for young men and women to enable them establish businesses to earn a living aimed at reducing unemployment;
- c) **The Uwezo fund (Kiswahili word for Ability)** that empowers women, persons with disabilities and youth that give seed money to the special interest groups as startup capital for businesses. It gives up to 5000 USD to one group.,
- d) **The Social Protection Fundis** given as credit and cash transfers to older members of society and people with severe disability. The target is for senior citizens beyond age 65 years.
- e) **30% procurement reservation** affirmative action to Special Interest Groups (SIG) that include women, persons with disabilities and the youth. The SIG access 30 % value of all all-public procurement tenders,
- f) There is the national Government Affirmative Action Fund, established in 2015 administered through female members of parliament to run programs targeting socio-

empowerment of women, youth, persons with disabilities, children and elderly persons.(Lichuma, 2017).

Prior studies have argued that although women and girls are progressing steadily in the Kenyan education systems, they still encounter challenges. While the Kenyan government has created policies that offer equal opportunities to all, it has paid much less attention to the way policy is converted into action.

The gender gap in primary education is not as wide as in higher education. According to the [Ministry of Education records](#), of the 85% of learners who progress from primary to secondary school, 30% proceed to higher education. Women account for just one third of total enrolments

RQ4: What recommendations to fill these gaps in form of intervention /projects/programs for

4.4.1 Recommendations on addressing Labor markets factors

A recent study posts that in Kenya, a nongovernmental organization *Dandelion Africa* employ a myriad of different interventions involving community engagement mechanisms in order to promote gender equality. This includes training boys to be advocates for change and girls to be leaders, as well as providing support for women to engage in entrepreneurship (and thereby have school fees for all their children). Additionally, they provide comprehensive sexual and reproductive health training and services. In the programming of their interventions, *Dandelion Africa* explicitly addresses gender-based challenges and both solicits and acts on feedback from participants to ensure the programming addresses their needs in a meaningful way (International Center for Research on Women (ICRW), 2019). Further they deploy a strategy where girls and boys work on community projects together, then follow the project with a discussion about the gender dynamics of the group during the project. This allows the group to reflect on how gender norms and roles affected them in their daily interactions with others (International Center for Research on Women (ICRW), 2019).

4.4.2 Recommendations on addressing Family formation

Despite progress in expanding access to education for girls globally, important barriers remain. Girls' success in school – and after leaving school – is determined in part by characteristics of and factors in her household and community. Many policies and programs are based on an assumption that continued progress toward gender equality in education is hampered by early marriage and adolescent pregnancy. While education and age at marriage (and pregnancy) are positively correlated in many settings, evidence of a causal relationship is more limited. The effectiveness of policies and programs aiming to improve

gender equality in education depends on a clear understanding of the barriers to success for girls, which are complex and vary between settings.(Psaki, 2016) .

4.4.3 Recommendations on addressing Psychological elements

More recently, literature has emerged that asserts it is a basic human right for children to feel safe in school and be spared premeditated humiliation resulting in bullying. Moreover, the society too expects schools to mold responsible citizens for sustainable development of modern society. Despite these expectations, current studies have established that the fear of being bullied when entering secondary schools in Kenya is rampant and persistent (Itegi, 2017). Thus, Itegi (2017) recommends intervention to empower teachers to enhance supportive school environment and collaboration among stakeholders.

Recent studies have articulated some interventions that teachers and additional efforts the Kenyan government must undertake to better protect all learners from sexual abuse(Adhami et al., 2018). Adhami et al. (2008) continue to argue that Girls' Education is under Attack and further articulate the detrimental impact of sexual abuse by Teachers on School girls. Although they have proposed legislation intervention to address the challenge, other researchers have adopted a multi-array of interventions to address this and other challenges. Indeed, in recent past a number of researchers have established that some of the interventions required to address the gender parity in education include empowering girls through self-awareness to deal with:

- **Gender stereotypes**, i. e. challenging stereotyping such as girls being unable to benefit from secondary education or less to succeed in mathematics and science,
- **Sexual violence**, abuse and harassment-raising awareness of these issues and using teachers to raise awareness of learners, Ideologies underlying the curriculum and school textbooks,
- **Curriculum choices**—e.g. inspiring girls to take science, mathematics, and technology subjects(Sifuna, 2006).

Further, these range of interventions require the building of schools and teacher's capacity to deal with their teaching styles to be more friendly to girls and women. This entails enhancing capacities that enhance teaching styles, including those that have inbuilt differential attention paid to boys and girls. The capacity should be built in the School organization and discipline in a view to making schools more girl-friendly(Sifuna, 2006).

4.4.6 Policies

The constitutions in Kenya guarantee every citizen a right to education. This is regardless of gender, sex, or social class. Higher education in particular holds great value for the public good. It is central to the development of individuals and nations. But there is still uneven development between genders. In Kenya women still struggle to access institutions of higher education. And

they also struggle to succeed in science, technology, engineering, and mathematics (STEM) related courses, and to progress into postgraduate studies(B. Akala, 2019).

5. METHODS

This study generally followed the seven -phase process developed by Onwuegbuzie and Rebecca, (2016) for systematic review studies. The approach is also supported by (Arksey & O'Malley, 2005). The systematic review of the literature has been used as the basis of the research. Although the extensive literature review could not be carried out because of the limit of various constraints, a considerable number of literatures has been reviewed. Additionally, to meet the objectives of this study and answer the research questions particularly question 3 and 4, we had to relax the essence of only published journal articles in the selected debases could be considered for review. This was arrived at by realizing that there are reports that are not published in the databases, but instead are accessible through the respective organizations repositories. This was implemented by reviewing selected reports from players and agencies like those of United nations, Kenya government and relevant governments departments, selected non-government organization and actors in gender issues. The literature has been provided prominently by the Emerald, IEEE, JSTOR, Online Willey, Taylor & Francis.

5.1 Planning the review

The systematic review of the literature (SRL) has been used as the basis of the research. Despite the fact that extensive literature review could not be carried out because of the limit of various constraints, a considerable number of literatures has been reviewed. The literature has been provided prominently by the Emerald, IEEE, JSTOR, Online Willey, Taylor & Francis. We planned the review process by refining the research objectives into a set of research questions. We also identified the search strategy, search strings, inclusion/exclusion criteria, and the quality assessment criteria to be applied on the extracted studies. We present these in more detail below:

5.1.1 Search Strategy for Identification of Studies

A number of prior studies have established a guideline for carrying out systematic review research (Pellas, Fotaris, Kazanidis, & Wells, 2018). Consequently, we defined the search space that included five electronic databases as shown in Table 1. In order to obtain a comprehensive view when answering our questions, it was essential to run our search on specialized databases from the two worlds: the computer science/engineering discipline and the education discipline, hence our selection for these four databases. The selected publication period was from January 2000 to the time of conducting the search December 2019. The initially retrieved studies from the electronic databases were analyzed. Then, the inclusion and exclusion criteria explained in Section 5.1.3 were applied to all of the studies kept after an initial analysis to filter the remaining papers.

5.1.2 Search criteria

The search criteria used for this review consist of three parts defined as follows:

- Keyword1 is a string made up of keywords related to gender diversity such as (Gender Diversity OR Equity OR Parity OR Equality),
- Keyword2 is a string made up of keywords related education such as (Education* AND Enrollment OR Teaching OR Learning OR Achievement),

- Keyword3 is a string made up of keywords related education subject such as (STEM OR Mathematics OR Science OR Engineering OR Technology OR “English Language”), and
- Keyword4 is a string made up of keywords related Kenya subject such as (Kenya OR Kenya*).

Table 1: Search Databases Sources

| Electronic databases | Searched items | Search applied on | Language | Publication period |
|----------------------|--|---|----------|---|
| 1. Emerald | Journal, workshop, and conference papers | Full text—to avoid missing any of the papers that do not include our search keywords in titles or abstracts but are relevant to the review object | English | From 1 January 2000 to 31 December 2019 |
| 2. IEEE | | | | |
| 3. JSTOR | | | | |
| 4. Online Willey | | | | |
| 5. Taylor & Francis | | | | |

The Boolean expression search criteria was Keyword1 AND Keyword2 AND Keyword3 AND Keyword4. An example of a search done in the electronic databases is (Gender Diversity OR Equity OR Parity OR Equality AND Education* AND Enrollment OR Teaching OR Learning OR Achievement AND STEM OR Mathematics OR Science OR Engineering OR Technology OR AND Kenya OR Kenya*). We composed the search strings in each of the five databases manually based on the search functionality offered by the respective database. Then we applied the same or variations of the search strings to general Google search engine to give us reports in Portable Document Format (PDF) related to the Kenyan context.

5.1.3 | Inclusion and exclusion criteria

To determine whether a study should be included, we used the following inclusion and exclusion criteria: **Inclusion criteria:** (a) the study is a peer-reviewed publication; (b) the study is in English; (c) it is relevant to the search terms defined above; (d) it is an empirical research paper, an experience report, or workshop paper; or a systematic literature review and (e) the study is published between January 2000 and December 2019. **Exclusion criteria:** (a) studies that do not focus explicitly on Gender Diversity (b) studies that do not address the education domain; (c) studies that do not meet the inclusion criteria; and (d) all other items that are typically assumed to be non-reviewed including prefaces, tutorials, anecdote papers, books, keynote, viewpoint, editorial comments, and only presentations slides. However, the exclusion condition (d) was relaxed for reports of international bodies like the united nations, International labor organization and others.

5.2. The data coding and analysis processes

All of the articles from the five journal databases were coded and analyzed. The first research question (RQ1) What’s is the status of Gender parity in education in Kenya? Address the

publication year, and the distribution in the selected databases. The year is the date of publication in the journal, which is indicated in the article. Database is the source of the journal article.

6. ANALYSIS, RESULTS & FINDINGS

RQ1. What’s is the status of Gender parity in education in Kenya

To address distribution of the journal articles, we analyzed the distribution over time of the studies published in the -indexed journals that examine gender diversity in education in Kenya by pursuing answers to the studies distribution on the following two aspects:

- a. Distribution over the 2000-2019,
- b. Distribution in selected indexed journal databases, namely Emerald, IEEE, JSTOR, Online Willey, and Taylor & Francis.

1.1 Distribution Over the Years

The analysis of the distribution of the articles on gender diversity in education across the years of publication, revealed that starting in 2000, the number of studies generally increased over time.

Table 2: Inclusion and exclusion criteria.

| Inclusion criteria | Exclusion criteria |
|--|---|
| <ol style="list-style-type: none"> a) Must involve Gender AND diversity OR Parity OR Equality AND Kenya either in the title or inside the continent of the article. b) The article must be having aspects of gender diversity or discussing issues that affect equality which in turn affect gender diversity in education c) Reports form international and government agencies addressing gender diversity or youth problems as one of their items in the narrative d) Reports from ongoing Interventions projects/ programs | <ol style="list-style-type: none"> a) Editorials, magazines, newspapers and other non-journal sources are excluded. b) Articles that mention the term “Smart Devices”, and/or Tablets and/or iPad, and or Smart phone, but are actually about the devices themselves or other topics. |

Figure 3 Gender Diversity in Education in Kenya research has intensified during the last two decades years. This suggests that a similar level of interest will continue in the next decade stating

2020 and beyond. Particularly in interventions to address gaps on Psychological elements including:

- a. Bullying in schools (Itigi, 2017; Ndeti et al., 2007)
- a) Sexual harassment Violence against Girls (Buluma ichael, 2009; Baiocchi et al., 2019),
- a. Poor implementation of policies (Adhami et al., 2018),
- b. Teachers lack of capacity to deal with gender issues in schools,
- c. Girls not empowered to deal with Gender stereotypes,
- d. Girls not empowered to deal with Sexual violence abuse and harassment, and
- e. Girls not empowered to deal with curriculum choices (Sifuna, 2006).

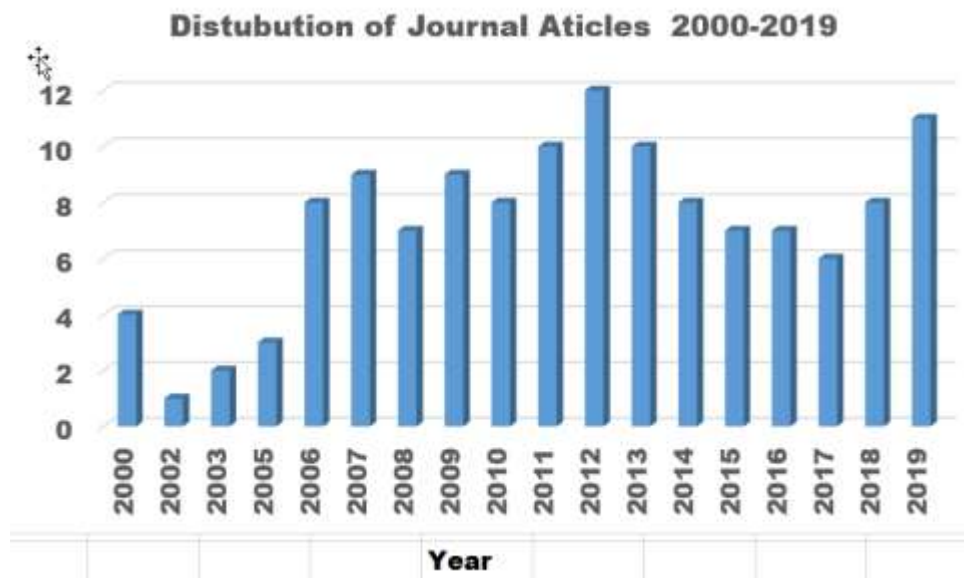


Figure 3: Number of Articles Published by Year

1.2 Distribution Over Journal Databases of Research

Figure 2: Comparison of Smart Devices Researches in Africa and Globally

Out of the 130 reviewed studies from five indexed journal databases were involved. Figure 4 shows the number of articles on Gender diversity in education in Kenya. As shown in Figure2. Over three quarters of the articles were from the Taylor and Francis database. The five indexed databases were conveniently selected.

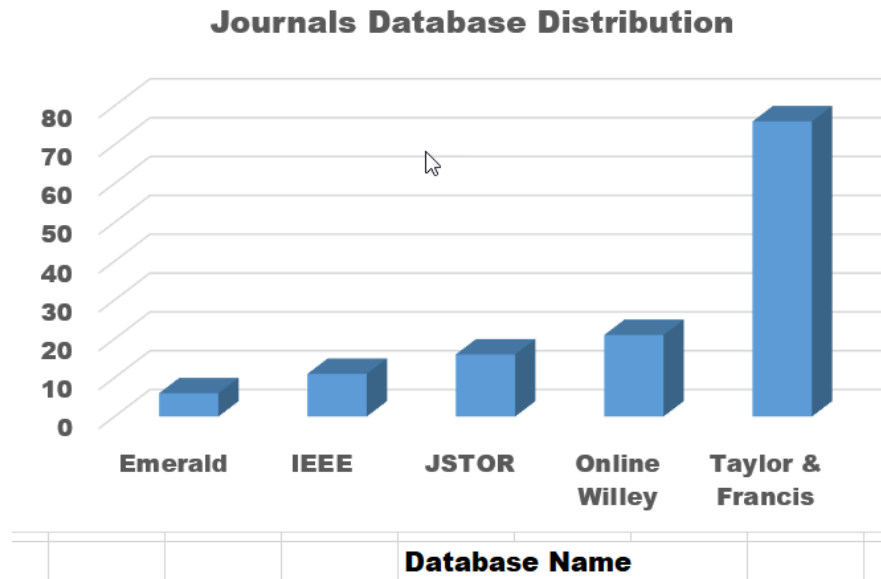


Figure 4: Sources of Reviewed Journals

RQ2. What intervention /projects/programs are in place to bridge the gaps in gender parity in STEM education in Kenya.

The following is a sample of interventions were established to have sufficient success:

- a) "1. introduction of tuition fees by the government
- b) "1. providing the families with information about community activities related to learning skills, talents
- c) 2.mentoring and tutoring providing information about community social support services to parents as well as pupils
- d) 3.inviting professionals to tackle specific social issues
- e) 4. matching the school goals with the community's contributions."
- f) "Documentation strategies to support the adoption of digital technologies within gender-inclusive ICT programs."
- g) Massive admission of women /girls in universities.
- h) women showing very positive attitudes toward gaining an IT education.
- i) By educating women there is reduction in fertile rate hence low productivity that causes reduction of poverty
- j) "It was Noted that non-disabled children were more active than disabled learners.
- k) Peer motivation, in particular by family members and friends, is one of the main factors influencing participation in physical activity among populations,"
- l) "since low-cost private primary schools are able to outperform their government counterparts whilst operating with relatively low overheads, not only do parents prefer to send their children to them, but the low-cost private school also has an important role to play in the achievement"

- m) "1. There is evidence of young men trying to use schooling to provide community leadership to transform 'their home' and there are indicative
- n) 2. signs that some young women are using the language of rights and individualisation to break out of gendered dependencies and divisions of labour."
- o) "'illiterate' women, or those with a very limited formal education, have become critical of their social environment and have taken learning initiatives to solve daily problems."
- p) Education access improved for more women in the second generation,
- q) Government has tried to ensure one-third rule on ethnic balance and the two-thirds rule on gender balance,
- r) Dramatic increases in the number of women joining the engineering profession
- s) M-learning allowed for location shifting with students able to learn from diverse physical locations using different portable gadgets, time shifting with students being able to access course materials any- time and on demand as well as interactivity with students being able to track their learning progress as well as the management of the learning environment with ability to provide online assessments, assignments, goals and expectations.
- t) Both male and female, are engaging in non-gender stereotyped occupations.
- u) They have increased the numbers of underrepresented students who enrol in and graduate from STEM programs. 1) Availability of equipment like computers 2) Availability of computer literate teachers 3) Support from school management 4) Positive attitude to ICT by teachers and students 5) Computer literate students
- v) The digital economy segment can be developed more easily and progressively than others (a mobile app can be developed in a garage by a single person). implementing digital education for (STEM) also supports the acquisition of digital skills. Finally, economic.
- w) The emphasis in identifying effective teachers has been on teacher characteristics associated with higher student outcomes. For example, some studies suggest that greater teacher experience contributes significantly to student achievement.
- x) There is rapid updating, sharing of information and instruction are conveniently performed. It promotes a team-learning pedagogy in which the primary focus is to foster a learning environment conducive to group interaction through collaboration and self-learning
- y) Increasingly looking to ICT for development projects to improve their social and economic development.
- z) Increased demand for flexibility in access and delivery, increasing globalization and more competition in higher education.
- aa) By determining instances of complementarity, practitioners, teacher educators, and researchers can be more knowledgeable and intentional about creating equitable, rigorous science learning experiences.
- bb) Government efforts to improve primary education for girls
- cc) The state provides greater access to education to improve the skills of the labour force, foster national integration, and correct inequalities in educational opportunity.
- dd) Increased women participation in higher education,
- ee) we may improve the performance of girls in mathematics through the use of programmed materials.

- ff) Positive influence on the pupils' classroom interaction patterns, the pupils in the treatment groups learned the concepts and methods better than their counterparts in the true control group.
- gg) Women sought to achieve gender parity and assume an active role in changing society. Second, women were motivated by more tangible economic and entrepreneurial aspirations for participating in the formal workforce.
- hh) Regardless of the medium of instruction, discourse in mathematics lessons remained teacher dominated and formulaic.
- ii) student teachers are allowed to use their home languages when they fail to speak in English.
- jj) some new course titles and new degree programmes appeal to women.
- kk) A stimulating home environment by availing reading materials at home for their children.

RQ3. What gaps exist in the intervention /projects/programs for Gender parity education in Kenya

The following is a sample of gaps in existing interventions were established:

- a) Gender bias in classrooms (Mungai, 2012)
- b) To increase female participation in public universities in particular, there is the need for some affirmative action, especially in the more competitive courses like medicine, engineering, technology and architecture, through the adoption of more flexible admission processes which would include crash remedial programmes, especially bridging courses in these areas and allowing for credit transfers for students enrolled in technology-based tertiary institutions such as Kenya. (Sifuna, 2006)
- c) People are not educated about changing and challenging social norms to prevent social gendered violence.(Cobbett-Ondiek, 2016)
- d) cultural imperialism that continues to subordinate and marginalize certain groups such as refugees.(Muftee, 2014)
- e) 1.Sexual violence remains an unaddressed problem in the education sector.
2. Addressing the issue on why female students are affected, then male there still exists a gender gap. On how students are affected, there still exists a gender gap.
3.Addressing the issue on why young women and girls experience much higher levels of violence that reflect broader gen-der inequalities in society.(Abuya, Mutisya, & Ngware, 2015)
- f) Tackling the issue of youth getting radicalised
 - a. Creation employment opportunities,
 - b. improve education system that does guarantee gainful employment to the youth.
 - c. creation of jobs on completion of education(Carr-Hill, Mbwika, & Peart, 2019)
- g) The access to ICT and ICT training (most often in combination) has in several ways improved the livelihoods and income generating abilities of many of the SC participants.(Hatakka, Ater, Obura, & Mibei, 2014)
- h) Increased access to primary education of children who normally would not have attended school especially girls.(Sifuna, 2012)

- i) Increased opportunities are provided through flexible admission and recruitment criteria, a conducive working environment and the appointment of more women into senior management positions.(Osongo, 2007)
- j) The introduction of the biNu and World reader apps sparked new forms of mobile appropriation among the girls at NDSS by offering content otherwise unavailable due to affordability.(Zelezny-Green, 2018)
- k) Social norms are evolving, and the opportunity for adolescents to receive comprehensive sex education from parents and other adult role models is emerging.(Agbemenu & Schlenk, 2011)

Additionally from the fold study by **Ndiku, Aurah, Okoth, Ogenga, and Ongus, (2020)**, the following gaps were proved:

- a) Government removed requirements needing students to buy books. Government does not supply readers. The only reading material is set books. This leaves the teacher as the key resource. Key Informant Interview (KII) with subject teacher.
- b) Students strictly depend on set books by government. There is no variety of books. We have insufficient set books and pace setters. (KII with subject teacher)
- c) Limited resources like class readers and CDs on pronunciation which school is unable to provide. You then find that parents do not buy saying the government provides books... what is provided does not include readers.
- d) The policy on 100% transition from Primary level to secondary level has brought many challenges. There is hardly a space in the classrooms. We handle many students in a single stream, yet Mathematics requires regular supervised individual class practice and assignments. This is greatly compromised in the current situation. We are overwhelmed.
- e) Ideally, we should have a fully equipped Mathematics room. This way, the teachers can make adequate preparations while the students can undertake as much practice (KII with teacher of Mathematics)
- f) Available laboratory is too small for all the students. This is because Chemistry is a compulsory subject. I have had to plan and conduct practical sessions on Sundays. This way, they come in small groups (KII with teacher of Chemistry)
- g) Teaching of Chemistry requires a lot of reagents. The problem is that the school cannot afford to buy adequate reagents for all the students (KII with teacher of Chemistry)
- h) . Examples were ACK Ebusakami girls, Bukulunya secondary, St. Luke's Shisango girls, and Kobura girls. Large population due to the government policy on 100% transition from primary to secondary. The negative effect of this is large class sizes that hinder small group experiments and individualized attention. It also implies that the resources are stretched.
- i) Teacher: "You are forced to speak to jua kali people to make some apparatus for you"
- j) All topics from Form II are practical that require students to work with computers. (KII with computer teacher)
- k) Accessing computers is a challenge to learners. In Form II all topics are practical but we have 6 computers against 108 students (KII with computer studies teacher (Ndiku et al., 2020). Similar gaps were also proved for students and teachers.

RQ4. What recommendations to fill these gaps in form of intervention /projects/programs for Gender parity in STEM education in Kenya

Some of the highlights from teachers involved in Ndiku et al. (2020) study include the following interventions:

- Provision of Text books- E-books and physical books
- Construction and equipping of additional Laboratories to cater for increasing number of students enrolled in the schools.
- Construction and/or equipping of libraries with relevant books and materials
- Construction and/or equipping of Computer laboratories with computers and other digital devices
- Purchase and provision of Digital content to supplement and complement the existing inadequate learning resources.
- Capacity building for teachers on innovative pedagogy in English and STEM subjects.

Further the literature review and the systematic review established the following gaps and corresponding recommended interventions shown in Table 3:

Table 3: Summary of Recommendations to fill gaps in form of intervention

| Gender Parity Variable | Gaps Identified | Recommended Interventions | Citation |
|---------------------------------|--|---|--|
| 1. Labor markets factors | <ul style="list-style-type: none"> • Discrimination by employers • Insufficient Technical Skills | <ul style="list-style-type: none"> • Bann Domestic labour market • Increased opportunities through flexible admission and recruitment criteria, • Provide a conducive working environment • Appointment of more women into senior management positions. • Skill development for the less privileged Gils and Boys | (Mungai, 2012) (Dilli et al., 2019). Klasen and Lamanna, (2009) (Kimani & Kombo, 2010). (Osongo, 2007) |
| 2. Family formation | <ul style="list-style-type: none"> • Teenage Pregnancy • Lack of sex education | <ol style="list-style-type: none"> a. Empowering girls with information, skills and support networks b. Educating and mobilizing parents and community members c. Enhancing the accessibility and quality of formal schooling for girls d. Offering economic support and incentives for girls and their families e. Fostering an enabling legal and policy framework | (Omari, 2016) (Malhotra et al., 2011) |

| | | | |
|----------------------------------|--|---|---|
| 3. Culture versus nurture | <ul style="list-style-type: none"> Native Language | <ul style="list-style-type: none"> Enhance culture of reading Enhance English Language teaching and learning | (Abd-Kadir & Hardman, 2007) |
| 4. Psychological elements | b) Bullying in schools | <ul style="list-style-type: none"> Empower teachers to enhance supportive school environment and collaboration among stakeholders | (Itegi, 2017) |
| | c) Sexual harassment Violence against Girls | <ul style="list-style-type: none"> Build teacher trainees capacity in sexual harassment and violence. strengthen guiding and counseling in schools to guide both teachers and students in dealing with sexuality issues. Empowerment self-defense approach | (Buluma ichael, 2009) (Ndetei et al., 2007) (Abuya, Onsomu, Moore, & Sagwe, 2012) (Atieno & Nairobi, 2017) (Adhami et al., 2018) (Baiocchi et al., 2019) |
| | d) Poor implementation of policies | <ul style="list-style-type: none"> Legislation | (Adhami et al., 2018) |
| | e) Teachers lack of capacity to deal with gender issues in schools | <ul style="list-style-type: none"> Improving School organization and discipline by building School and Teachers capacity to deal with gender issues making schools more girl-friendly | (Sifuna, 2006) |
| | f) Girls not empowered to deal with Gender stereotypes | <ul style="list-style-type: none"> Empower girls to challenge stereotyping such as girls being unable to benefit from secondary education or less to succeed in mathematics and science | (Sifuna, 2006) |
| | g) Girls not empowered to deal with Sexual violence abuse and harassment | <ul style="list-style-type: none"> raise awareness of these issues and using teachers to raise awareness of learners | (Sifuna, 2006) |
| | h) Girls not empowered to deal with curriculum choices | <ul style="list-style-type: none"> Ideologies underlying the curriculum and school textbooks, inspire girls to take science, mathematics, and technology subjects | (Sifuna, 2006) |

| | | | |
|------------------------------------|---|--|--|
| 5. Family background | a) Lack gender mainstreaming by the government in poverty reduction interventions | Gender mainstreaming by the government in poverty reduction interventions. | (Kimani & Kombo, 2010)(IMF, 2004) |
| 6. Policies e.g. on poverty | <ul style="list-style-type: none"> • Policy gaps between broad national plans, frameworks, routine sector actions and projects • Lack gender mainstreaming by the government in poverty reduction interventions | <ul style="list-style-type: none"> • Closing the gap between framework and implementation | (Kimani & Kombo, 2010), (Abd-Kadir & Hardman, 2007) (Wasonga, 2013) |

The study Ndiku et al., (2020) established specific out gender issues in STEM education. Day schools and Mixed schools had conspicuous issues calling for interventions. Among the plausible interventions include:

- 1) **Boy-girl relationship** which impacts the performance of the students. The affected boys and girls have registered poor performance in their academics. This is rampant in mixed day schools. A more strengthened and structured guidance and counseling department need to be put in place to help the students cope with this challenge.
- 2) **Teenage mothers** that affect girl-child education. It was revealed that girls from poor background face a lot of challenges and are usually wooed by older men and "Boda boda"(motobike) riders into early marriage. Consequently, there is need for strict implementation of the law that forbids early marriages. Further, stakeholders should come up with more empowerment programs.
- 3) **Teenage pregnancy** was identified as another gender-related issue affecting the girl-child. Consequently, a more strengthened and structured guidance and counseling department

need to be put in place to help the students cope with this challenge. Further, stakeholders should come up with more empowerment programs.

- 4) **School drop-out** was another issue reported to affect more so the girl child. Factors leading to school drop-out were identified as family-related where parents are unable to meet the academic demands such as school fees and personal effect of their children. Consequently, stakeholders should come up with more robust financing mechanisms so that students don't drop out of school for lack of fees.
- 5) **Insecurity:** In day schools girls walk long distances to school and face insecurity issues and risks of rape and other forms of sexual harassment. Consequently, the government should ensure safety and security of all students inside and outside of the learning institutions. Further, stakeholders should also come up with more empowerment programs such as bicycle for education empowerment program (Ndiku et al., 2020).

7. DISCUSSION

Many of the gaps identified by both the literature review and systematic literature review agree with the findings field study by (Ndiku et al., 2020)

8. CONCLUSIONS

Many of the plausible interventions identified by both the literature review and systematic literature review agree with the findings field study by (Ndiku et al., 2020). In short we conclude that Gender diversity in education and particularly in STEM subjects is huge in Kenya despite many government and stakeholder involvements. Consequently a myriad of interventions area necessary including:

- a. Empower teachers to enhance supportive school environment and collaboration among stakeholders
- b. Build teacher trainees capacity in sexual harassment and violence.
- c. strengthen guiding and counselling in schools to guide both teachers and students in dealing with sexuality issues.
- d. Empowerment self-defence approach
- e. Legislation
- f. Improving School organization and discipline by building School and Teachers capacity to deal with gender issues making schools more girl-friendly
- g. Empower girls to challenge stereotyping such as girls being unable to benefit from secondary education or less to succeed in mathematics and science
- h. raise awareness of these issues and using teachers to raise awareness of learners
- i. Ideologies underlying the curriculum and school textbooks,
- j. inspire girls to take science, mathematics, and technology subjects
- k. Gender mainstreaming by the government in poverty reduction interventions, and
- l. Closing the gap between framework and implementation

9. RECOMMENDATIONS FOR FURTHER WORK

7.5 Recommendations for Further Research

Suggested below are some of the areas that require further investigation.

- 1) Influence of Smart devices on the teaching and learning of STEM subjects
- 2) Influence of access to digital learning and digital library on the teaching and learning of STEM subjects
- 3) Poor performance in STEM Education among secondary school students.
- 4) Gender disparity in enrolment and performance in STEM subjects among secondary school students.
- 5) Teen pregnancy, incest, early marriages, and school dropout among secondary school students.
- 6) Poor performance in English, the role of reading for pleasure, and the correlation between English and STEM Education.
- 7) Baseline survey on STEM Education on a national scale.

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