GENDER AS A DETERMINANT OF STUDENTS' PARTICIPATION LEVELS IN SCIENCE FAIR COMPETITIONS IN SECONDARY SCHOOLS IN KIAMBU COUNTY, KENYA

BY

MAUREEN MUTHOKI NZUSYO, BED (ARTS)

C50/NKU/PT/26644/18

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DECLARATION

THIS THESIS IS MY ORIGINAL WORK AND HAS NOT BEEN PRESENTED FOR A DEGREE IN ANY OTHER UNIVERSITY.

SIGNATURE_____ DATE_____

NAME: MAUREEN MUTHOKI NZUSYO

C50/NKU/PT/26644/18

SUPERVISORS:

THIS THESIS HAS BEEN SUBMITTED FOR REVIEW WITH OUR APPROVAL AS UNIVERSITY SUPERVISORS:

SIGNATURE _____ DATE _____

DR. GLADYS NYACHIEO

DEPARTMENT OF SOCIOLOGY, FACULTY OF SOCIAL SCIENCES AND TECHNOLOGY

MULTIMEDIA UNIVERSITY OF KENYA

SIGNATURE_____ DATE_____

DR. MUTHONI MAINAH

DEPARTMENT OF SOCIOLOGY, GENDER, AND DEVELOPMENT STUDIES

KENYATTA UNIVERSITY (STATE INSTITUTION OF THE SUPERVISOR)

DEDICATION

This work is dedicated to my parents, Mr and Mrs Pius Nzusyo for instilling the virtue of hard work in me.

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Firstly, I thank God for guiding me all through this study. I am also grateful to my immediate family for their support and understanding during the entire duration of my studies.

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ABBREVIATIONS AND ACRONYMS

STEM: Science Technology and Mathematics

MOE: Ministry of Education

UNESCO: United Nations Educational, Scientific and Cultural Organization

MOEST: Ministry of Education Science and Technology

SSE: Subsidized Secondary Education

RSC: Royal Society of Chemistry

CAWMSTD: Commission of the Advancement of Women and Minorities in Science and Technology Development

WHO: World Health Organization

NESP: National Education Sector Plan

VET: Vocational Education and Training

PRiSE: Persistence Research in Science and engineering projects

GD: Gender Differences

USA: United States of America

NGO: Non-Governmental Organization

SPSS: Statistical Package for Social Sciences

GenderinSITE: Gender in Science, Innovation, Technology and Engineering

WIS: Women In Science

IAP: Inter Academy Partnership

ISC: International Science Council

NACOSTI National Commission for Science, Technology& Innovation

SF: Science Fair

SFC: Science Fair Competition

STEM: Science, Technology, Engineering & Mathematics

OPERATIONAL DEFINITION OF TERMS

Gender: A social and cultural construct that highlights the contrasts between the traits of men and women, as well as between boys and girls, and, in turn, makes reference to the roles and obligations of men and women.

Determinant: An element that is responsible for the nature of something. This study will investigate gender as an element that is responsible for participation of boys and girls in science fairs and will be examined by examining indicators such as gender stereotyping, gender biasness, available role models and the science teacher factor

Students' participation levels: This will imply the sum of girls and boys who participate in science fair and the nature of projects they select such as mathematics projects, physics projects and others, as well as levels of competition reached; such as zonal, county, regional or national levels.

Science Fair competitions: A competition in which contestants create science related projects or demonstrations for example mathematics projects. The teams or individuals with the most innovative projects or demonstrations are declared winners.

Secondary schools: Learning institutions between primary and tertiary levels, in the Kenyan context.

Co-Curricular Competitions: Out of class contests, extra-curricular contests (in a school setup) for example, athletics, music, drama, science fair. The most outstanding item is awarded the highest score.

gender related challenges: challenges unique to women and men, boys and girls. For instance, participation of girls and boys in science -oriented competitions may be affected by gender stereotypes whereby physical science has traditionally been viewed as a man's field whereas girls have been expected to outdo boys in social sciences and humanities.

Gender Responsive strategies: Intentionally incorporating gender concerns to influence program and policy design, execution, and outcomes. aims to take into account the priorities, needs, and interests of both men and women, boys and girls.

ABSTRACT

Despite longstanding efforts by governments and international bodies to promote women's involvement in science and technology, women remain underrepresented in most scientific fields globally (UNESCO, 2017). This disparity is often linked to early education experiences, including limited participation in science-related co-curricular activities (Akala, 2010). It is assumed that participation in science-oriented co-curricular competitions such as science fairs boost students' performance and interest in the science subject. This study sought to analyse Gender as a Determinant of Students' Participation levels in Science Fair Competitions in Secondary Schools in Kiambu county-Kenya. It investigated whether the situation is the same in the identified area of study. Specifically, it explored gender differences in the number of boys and girls participating in selected science fair competitions from 2012 to 2021 in secondary schools in Thika west sub-county, examined the selection processes in schools for representation in science fair competitions among secondary school boys and girls in the area of study, determined the factors influencing participation in the said science fair competitions, and also identified gender responsive strategies that can ensure gender equitable participation in these fairs. Using a descriptive survey design, the study sampled 350 respondents through purposive, simple random, and stratified sampling. It was guided by Social Role Theory and collected data using questionnaires for students and structured interview guides for science teachers. Data collection techniques included self-administration of questionnaires to selected students and conduction of structured interview guides to selected science teachers by the researcher. It obtained secondary data from literature on gender and science, and science fairs. Quantitative data was analyzed using SPSS (version 23) which was present in frequencies, counts, percentages, tables and figures, while analysis of qualitative data was done using content analysis and presented thematically and verbatim**.** Findings showed a gender gap in participation favoring boys, despite schools employing gender-sensitive selection processes. Key barriers to female participation were found to include: Gender stereotypes and ideologies, lack of female role models, limited career guidance and sexual harassment. The study proposed strategies such as organisation of workshops to boost self-image and creation of gender equality awareness. Finding of the study offer valuable insights for the Ministry of Education and other stakeholders to supervise gender mainstreaming in science fairs in secondary schools since evidence exists that there is a gender discrepancy in participation in science fairs in secondary schools (Steegh, 2021).

CHAPTER ONE

1.0 INTRODUCTION

This chapter highlights background to the study and captures the statement of the problem, objectives of the study and the research questions. It also captures study assumptions, justification and significance of the study and lastly scope/ limitations and delimitations.

1.1 BACKGROUND TO THE STUDY

The quality of human life has unquestionably been greatly improved by science and technology. Consequently, this has prompted a worldwide effort by nations of actively supporting the essential duty of research in identifying verifiable answers to the very difficult issues facing the world (UNESCO, 2021). Gender equality in participating in scientific innovation at all levels is therefore desirable for maximum benefit to individuals and nations (Thornton, 2019). This study is therefore timely as it researched on gender as a determinant of participating in science fairs, as studying participation in science fair is one aspect of studying participation in science (Steegh, 2021).

According to a global analysis of participation of women in science, the average global representation of women is 30% (UNESCO, 2017), with the following regional distribution: Arab States: 40.9%, Central and Eastern Europe: 39.0%, North America and Western Europe: 32.9%, Sub-Saharan Africa: 31.1%, East Asia and the Pacific: 25.0%, South and West Asia: 23.1%, Latin America and the Caribbean: 45.8%, Arab States: 40.9%, Central Asia: 48.5%, and Central and Eastern Europe: 39.0% (WIS, 2020). Data therefore shows that women are seated on a less comfortable platform than men, as they try to access technology (Beura, 2017; UNESCO,2017). Again, women's participation in research appears to drop after the master's level of education and steadily declines with each step further up the research hierarchy so that globally only 28.8% of

researchers worldwide are female (UNESCO, 2017). This leads to the question, why is it that women face more challenges in pursuit of research careers compared to men? It also implies that barriers and difficulties exist that prevent more women from pursuing careers in science and technology.

Participation in science fair provides one context of examining the development of gaps in gender in activities connected to science (Lawton & Bordens, 1995). Science and Engineering fairs, (often referred to as simply science fair) can spark students' interest in science and increase their positive attitudes toward it (Bruce, & Bruce, 2000). Additionally, science fairs have a favorable impact on students' desire to pursue scientific vocations and placement at prestigious universities (Steegh, 2021). Lakin, Ewald, Hardy, Cobine, Marino, Landers & Davis (2021) similarly observe that scientific fairs are important educative activities trusted to foster the engagement of students in science. This suggests that gender gaps in science fair contributes to gender disparity in scientific fields.

Globally, the proportion of women and men participating in science fairs varies. Jones (1991); Greenfield (1995); Lawton & Bordens (1995); & Adamson, Foster, Roark & Reed (1998) established that the participation of males was much higher than that of females in USA. However, Greenfield (1995) also found out that females' participation has improved greatly compared to 20 years ago, with noted increase in female participation in physical sciences over the years. Similar to Jones (1991) and Lawton, & Bordens, (1995), she also concluded that the likelihood of women to participate in mathematical, physical and, earth science, is lower than that of men. Recent research on the other hand indicates commendable improvement for some countries. For instance, according to UNESCO (2021), Venezuela has achieved gender parity with a representation of 61.4% of women in research though disparity was noted in areas like Haiti and Cuba. Thornton

(2019) on his part identified states such as Guatemala, Trinidad, Argentina, Tobago, Panama and Bolivia to have achieved over 50% researchers as females. Additionally, Academies of Young Scientists were reported to have women as the larger share of members (GenderinSITE, 2021). These studies present gaps in gender as far as participation in science fairs is concerned.

In the EU, an average of 41% of engineers and scientists are men, however, women outnumber men in those professions in countries like Portugal and Lithuania (Thornton, 2019). He also adds that women researchers are less than 30% in Luxembourg, Finland, Germany and even Hungary. Additionally, Vinković, & Potocnik (2010) placed Croatia at the bottom of the other countries as far as participation in science is concerned. High School students in Croatia were also ranked last in involvement in mathematics and sciences in Europe, and their desire in pursuing careers in sciences was reportedly waning. This was attributed to failure to expose the youth in science activities, such as science fair, at an early age. On the other hand, Korkmaz (2012) noted that boys in Turkey preferred to choose physics projects while girls chose projects in biology and social sciences, regardless of grade level, and that boys were more confidence in their projects than girls. This, he termed as gender stereotyping of projects and associated it with science teachers and gender biasness in media portrayal. This brings to mind that as early as in school, gender is already playing a role in determining participation in science and innovation.

The number of women studying science and technology in India is increasing, according to data (Gupta, 2019). However, he notes that though the number of women obtaining doctorates in various branches of science and technology is rising annually, the number of women scientists joining the industry is not increasing at a comparable rate. He suggested putting a gender equity focus on career days, scientific fairs, and awareness campaigns to help with this. Similarly, Beura (2017) observed that as late as in the 21st century, in several countries, the statistics of women in

physics, engineering and computer science was as low as below 30%, and linked this to challenges that women face trying to access science and research. He identified factors responsible for this to be inequality in distribution of resources and gender biasness and prejudices and advised among other things yearly organization of fairs and quizzes at several levels for both secondary and primary learners, mainly targeting females to boost interest in them. Thus, the fact that women have lower likelihood than men to participate in science and science fairs seems perverse in many countries.

Africa tells a similar tale. Prior to 1970, African women had never been given significant representation in planning for science (Kimani, & Mwikamba, 2010). They observed that a dramatic shift in thinking basing on fundamental assumption of human justice and equality is essential to make this transition since gender bias and technological inequities are so firmly ingrained in African sociocultural norms and values. In addition, in Africa, female scientists rarely work as research directors or Principal Investigators, rather, they work at junior posts (UNESCO, 2018). This gender gap is seen to roll back to school days where boys are reported to be more active in science than girls are (Akala, 2010). Therefore, this intensifies the relevance of the current study which tried to seek the truth of the matter participation in science fairs in schools in the area of the study.

On the other hand, UNESCO (2017) identified countries like Tunisia as having achieved gender parity at 56.1% women researchers. This is a major score and a source of encouragement. However, other countries were found to be progressing quite slowly. For instance, UNESCO (2021) found The Democratic Republic of Congo to be at 8.7% women researchers (in 2015) and Chad at 3.4% (in 2018). This implies that Africa is heterogeneous and therefore it is important to find out the case for individual countries too.

In Kenyan context, science fairs are enshrined in the basic education act (2014) and are meant to boost performance in STEM subjects as well as strengthen research, science, technology and innovation (MOE, 2019). They also offer students across the country an opportunity to become enthused by science and explore scientific research, as they encourage innovative thinking for practical solutions in everyday life (RSC, 2019). The government boosts performance of these fairs by both promotion and funding of co-curricular activities through the Subsidized Secondary Education (SSE) (Ndunguri, 2017). While this confirms that the Kenyan government highly appreciates the role of science fairs in advancing science and innovation, it creates concern that there is very little research in science fairs in the country.

Kimani (2010) established that women feature less than men in science and that the gap is even wider in the field of physics, however, his study was on participation in science subjects; According to Mbirianjau (2009), women made up just approximately 30% of students in VET institutions on a national level, and they were infrequently admitted to fields like engineering and information technology. His study was however on participation in VET institutions. On the other side, Muthike (2017) observed a beneficial connection between school administration support and students' involvement in extracurricular activities like scientific fairs. Her study was however generally on co-curricular activities. Mitchell, & Esmann, (2016) found out that science fair competitions in Kenya ended abruptly after the finalists were announced and awarded. Their study did not however adopt a gender perspective. Additionally, UNESCO (2017)) placed Kenya at around 28%, female researchers, which is too low. These studies confirm the need for a study on participation in science fairs with a gender perspective.

Much as studies on gender and participation in science fairs abound, gender disparity in this field still exists in favour of men (Beura, 2017). Why is it so? More still, evidence exists that there are

gender differences in choice of projects (Jones, 1991; Lawton, & Bordens, 1995; Greenfield 1995, 1996; Bunderson & Bunderson 1991 and Hazari 2013). The question therefore is, what brings this difference? Besides, there seems to be limited scholarly research on participation of girls and boys in science fair competitions in Kenya yet research has proved that science fairs boost students' interest in science and technology (Bruce, & Bruce, 2000; Steegh, 2021). This study is therefore timely as precise information is required on ways to increase gender parity in science fair participation in secondary schools hence reduce gender disparity in science.

Of interest too, is that Kiambu county has the largest number of national schools (8, with 3 in Thika west sub-county) in Kenya (MOE, 2021) in essence carrying the country's academic 'cream'. However, boys' and girls' participation in science fair in this county and sub-county is not to expectation. For instance, in 2018 the best performing students nationally came from Nairobi, Nakuru and Baringo counties (The Standard, 9th June 2018), while the best performing schools between 2010 and 2018 consecutively came from Nairobi County, with boys featuring more than girls in the fairs (Shree Cutchi Leva Patel Samaj School and College, 2020). This provokes the question, what limits full participation of these students in science fairs? It is against this backdrop that the researcher carried out research on 'Gender as a Determinant of students' Participation levels in Science Fair Competitions in Secondary Schools in Kiambu County-Kenya**.'**

1.2 STATEMENT OF THE PROBLEM

Background information has already stated how important science is. Every nation therefore aspires to generate as many qualified scientists as possible. Science fair participation has been connected to increased interest in science and increase in scientists, which would enhance living standards and lengthen life expectancy.

It is therefore expected that women and men participate equally in science and science fair at different levels. Participation of women has however been indicated to be as low as 30%. This is despite provision in the Kenyan Constitution of 2010 (section 27, 3) and National Policy on Gender and Development of 2000 (Sessional Paper No. 02 of 2019), which stress the significance of mainstreaming of gender in all development-related fields. This suggests that women who want to participate in science confront obstacles.

Data from national science fair also indicates that Kiambu county, which hosts most national schools nationally and therefore thought to have the best students overall, has not participated in science fairs as satisfactorily as Nairobi and Nakuru for some time. Similarly, in Thika-west sub-county, between 2017 and 2020, participation of girls in science fairs ranged between 27% and 41%. This gender disparity raises concerns about denying women access to scientific opportunities and impeding their economic and social advancement. Science is a lucrative industry that benefits scientists and can boost a nation's productivity growth by up to 2% annually. It would essentially be attracting men and women's attention, yet research shows that women trail behind.

Research on participation of women and men in science fair exists. However, participation varies in nations and regions. Besides, the reasons underlying the limited involvement of girls in scientific fairs in Kenya are little understood from an empirical standpoint. Additionally, little is known about how participation in scientific fairs is affected by factors like the availability of role models, media depiction, the role of science teachers and gender stereotyping. The researcher carried out the aforementioned study in light of this gap.

1.3 OBJECTIVE OF THE STUDY

1.3.1 Broad Objective

To explore gender as a determinant of boys' and girls' participation in science fair competitions in secondary schools in Kiambu County.

1.3.2 Specific Objectives

1. To quantitatively establish gender differences in the number of boys and girls who participated in selected science fair competitions in secondary school in Thika west sub-county, Kiambu, Kenya, from the year 2012 to 2021.
2. To examine the criteria and procedures used in the selection of students by gender for science fair competitions in secondary schools in Thika-west sub-county, Kiambu Kenya from the year 2012 to 2021.
3. To identify and assess key aspects that affect the participation of boys and girls in science fair competitions in secondary schools in Thika west sub-county-Kiambu – Kenya from the year 2012 to 2021.
4. To propose gender responsive strategies aimed at promoting equitable participation of boys and girls in science fair competitions in secondary schools in Thika-west sub-county-Kiambu –Kenya, from the year 2012 to 2021.

1.4 RESEARCH QUESTIONS

1. What are the gender differences in the number of boys and girls involved in selected science fair competitions from 2012 to 2021 in secondary schools in Thika west sub-county-Kiambu?

2. What were the selection processes in schools for representation by boys and girls in science fair competitions in secondary schools in Thika-west sub-county, Kiambu, from the year 2012 to 2021?
3. Which aspects affected participation of boys and girls in science fair competitions in secondary schools in Thika west sub-county-Kiambu from the year 2012 to 2021?
4. Which gender responsive strategies can ensure equitable participation of girls and boys in science fair competitions in secondary schools in Thika west sub-county-Kiambu -Kenya?

1.5 STUDY ASSUMPTIONS

This study assumed that learners' involvement in science fairs always guarantee interest and subsequent participation in science and technological innovation after school. It also presumed that all secondary schools in Kenya will benefit from the study's conclusions and suggestions. Again, it assumed that the chosen respondents would be open to participating and that their responses would be truthful.

1.6 JUSTIFICATION AND SIGNIFICANCE OF THE STUDY

In spite of meaningful global and national efforts to promote gender equality in education, disparities persist in learners' participation in science-related activities, including science fairs. In Kenya, science fairs are critical platforms that nurture students' scientific inquiry skills, creativity, and interest in STEM careers. Understanding gender as a determinant of students' participation in science fair is important as it helps to bridge gender gaps and inform policy and intervention design to enhance inclusive participation. While global and national trends are necessary, specific local contexts like Kiambu County may present unique challenges and opportunities and hence the study settled on Kiambu County purposively sampled. Thika-West

sub-county was suitable for the study as it hosts the highest number of national schools and hence hosting a variety of students (MOE, 2019).

The study is significant as it will enhance gender equity in science education through provision of insights into existing disparities**.** The findings will also assist policymakers, school administrators, and teachers in developing targeted interventions and policies that encourage greater participation among underrepresented genders, thus promoting inclusivity in science education. Besides, the study will add to the limited body of research on gender dynamics in extracurricular science activities in Kenya, specifically in Kiambu County, providing a basis for further research and comparison in other regions. Most importantly, by promoting gender-balanced participation in scientific fields from an early age, the study supports the broader goal of building a diverse and skilled workforce, critical for sustainable development in Kenya.

1.7 SCOPE/ LIMITATIONS AND DELIMITATIONS

The scope is limited to 5 out of 22 secondary schools in Thika west sub-county approximated to have 3,183 students (Kiambu county education office, 2021) and 53 science teachers sampled from the 5 schools making a total of 3,236 respondents.

The researcher chose to conduct the study in Thika since it is a metropolitan town inhabited by various people, and drawing its students from all over the country and indeed all over the world and therefore, assumed less prone to cultural norms that may interfere with girls' and boys' participation in scientific activities. In addition, as a metropolis, it is fairly representative of the situation in the country and possibly worldwide.

The study covered the period between 2012 and 2021. The year 2012 saw the starting of work of

developing the National Education Sector Plan (NESP) whose main aim, among others, is to increase the standards and significance of education laying emphasis on Science, Technology and Innovation, while 2021 captured immediacy of the research.

Besides other determinants influencing participation in science fair such as cognitive level, financial and administrative factors, the study only focused on gender determinants; specifically, those highlighted in the conceptual framework. The researcher anticipated encountering un-cooperative respondents who would have been unwilling to answer the questionnaires or give unreliable and inaccurate information regarding the subject matter during the study. To overcome this, the researcher guaranteed the respondents of confidentiality of their information and this made free to express their views on matters in question.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

20. INTRODUCTION

This chapter highlights literature relating to gender differences in the number of secondary school boys and girls involved in science fairs competitions, selection processes for participation in the fairs; aspects affecting the participation, as well as gender responsive strategies that can ensure gender equitable participation in science fair competitions. The literature has been reviewed per objectives. In addition, it documented theoretical framework and conceptual framework.

2.1 Gender Differences in participation in Science Fair Competitions

Jones (1991) carried out research on science competitions in the North Carolina, USA, in order to ascertain whether gender disparities (GDs) in participation and gender discrepancies in the subject areas chosen exist, (biological vs physical science). Just like UNESCO (2021), he observed that fewer females participated in all of the kinds of competition, and participated majorly on biological projects while there was heavy participation of males in the physics projects. In addition, Greenfield (1995) noted that female participation has grown in the past 20 years yet compared to the males, they are still less likely to participate in physics, earth sciences, and mathematical projects, and that they prefer projects based on library research over projects based on experiments. A similar study by Westbury (2017) however concluded that there were no worrying differences in female and male students' participation in scientific fairs and generally in their attitude towards science fairs in South Carolina.These studies were done in the USA while the current one is timely especially for a developing country like Kenya.

Korkmaz (2012) carried research in Turkey involving 514 science fair participants (age range 9-16) from grades 4-8 in a survey named 'tell us about your science fair experience' from different

primary schools in an urban area. He concluded that boys tend to choose projects on physics and girls on biology and social sciences. All of the students listed the first three sources for project ideas as being the scientific textbooks, parents, and television shows. Descriptive data revealed that boys participated more than girls. Thus, this study revealed gender differences in nature of project as well as number of participants. This study collected data from primary schools while the current study collected from secondary schools.

According to Beura (2017), regarding the general situation of involvement in science in India, women make up fewer than 30% of all scientific researchers worldwide. He goes on to say that women have more opportunities for normal self-expression in various disciplines, including science and technology, in nations where gender equality is seen as an essential element of a healthy society. However, he only investigated on the total number of women researchers while the current study investigated participation of both girls and boys in science fairs.

Ndlovu (2017) explored the background factors affecting participation of students, and their rate of success at the Expo for Young Scientists in South Africa's yearly scientific fairs for learners. Given that two out of every three participating students were female, he stated that the participation of girls exceeded expectations. He worked with a total of 36 schools which produced 329 learners of whom 153 were in junior secondary (grades 7-9) and exhibited 97 projects while 176 were seniors (grades 10-12) and exhibited 113 projects. Of the total, 112 learners were males while 217 were females registering a gender difference. His study explored only the regional level of competition in science fair while the current study explored several levels namely; sub-county, county regional and national levels.

Amunga & Musasia (2020) while studying the implication of the STEM gender gap on sustainable development goals in Kenya found out that women are generally underrepresented in

STEM careers in Kenya and voiced concern that this would probably make it more difficult to accomplish the Sustainable Development Goals, which include ending poverty and hunger. Besides, the Big Four Agenda may not be accomplished because doing so demands utilizing the skills of both genders. They connected this to gender gaps in involvement of students in science activities. While they got their data through literature synthesis and secondary data, the current study obtained data from both primary and secondary sources.

Agufana (2015) evaluated the impact of the national students' scientific congress in Kenya, on the development of biological education and found out that girls, especially in mixed day schools are less represented in science congress (fair) than boys. This passivity was also reflected in laboratory lessons and he concluded that for mixed schools, scientific activities are not experienced equally by both boys and girls. His study was however conducted in schools in Nairobi and involved mixed secondary schools only, while the current one was conducted in Thika-west sub-county and involved all kinds of secondary schools.

2.2 Selection Processes for Representation in Science Fairs

According to Grinnell, Dalley, Shepherd, and Reisc (2018), while non-competitive science fairs with a mastery goal orientation were found to be a better way to help all students learn about science and engineering in the USA, competitive science fairs with a performance goal orientation were more likely to be chosen by schools for student participation. Dionne, Trudel, Reis, Guillet, Kleine, & Hancianu (2011) conducted a different study to examine students' sources of inspiration for entering scientific fairs in 2008 in the entire Canada. It was shown that students were extremely motivated to participate in scientific fairs when they understood the rewards to expect from participating. On the other hand, depending on the students' interest in and dedication to participating in the fairs, the administrative body chose students to participate in the science fair. These studies used

constructivist learning theories together with motivation theories while this study used social role theory.

Kook, DeLisi, Fields &Levy (2020) in their 'Approaches for conducting middle school science fairs' described the most commonly conducted, encompassing strategies for middle school science fairs in USA. In their conclusion, school policies played a major role in determining which students would participate in science fair. Students who did well in sciences got full support from the administration to carry out their projects compared to those whose performance was less appealing. However, their study used only purposive sampling method to arrive at participants while the current combined purposive, simple random and stratified sampling techniques. They also failed to give their study a gender approach unlike the current study.

Lakin, Ewald, Hardy, Cobine, Marino, Landers & Davis (2021) carried out research in Alabama and observed that teachers dictated who to participate in science fair. This appeared to have a detrimental effect on schools' efforts to build a sustainable infrastructure for S&E fairs and promote STEM through the use of Scientific &Engineering fairs. It also had a negative impact on whether or not students would complete their projects. Those who willingly chose to undertake science fair projects had a higher chance of completing (86%) their projects compared to those who had been requested to undertake the same. These researchers used learning theories whole the current study used social role theory.

Mbowane, De Villiers & Braun (2017) found out that Eskom Expo for Young Scientists fairs stimulated participation from South Africa's most creative and talented students. Schools however were left with the duty of deciding which students to participate in the fairs and which ones not to. They also found out that, because these fairs depend on teachers to inspire students and help them find possible projects, school policies and science teachers play a significant

effect in determining who participates. Their study however got respondents only from science teachers while this study got respondents from both secondary school students and science teachers.

Mwangi, George & Thinguri (2013) found out science teachers, directly and indirectly influenced students' choice of physics as a subject to select for study in secondary schools. Directly, it was discovered that boys who frequently outperformed girls in physics and mathematics pleased physics teachers at mixed-gender schools more. Indirectly, these teachers had higher prospects for the boys' excellence in the subjects they teach in the KCSE exam. In their argument, this is one reason accounting for girls' lower involvement in the physics science fair projects in Kenya. Their study dealt with physics projects only while the current study involved all science projects in science fairs.

2.3 Aspects affecting participation of students in Science Fairs

Research in USA by researchers like Lawton, & Bordens (1995) & Greenfield (1995) have argued that the male advantage in physics is due to informal knowledge acquired through outside-school activities like working with electricity, tinkering with mechanical devices, building models, and using scientific tools. However, Lawton, & Bordens (1995) capitalised on project topics and worked with respondents all the way from kindergarten to grade 12, while the current study got respondents from secondary schools. Others like Cheryan, Plaut, Davies, & Steele (2009) demonstrated that stereotypical exposure to situations associated with computer scientists affects the gender gap in interest in computer science. Their study was limited to computer science while the current is inclusive of all sciences.

Other studies by Grinnell, Dalley & Reisch (2021) established that ethnicity was a major factor responsible for participation of students in science fair in USA, with black students worst affected at only 4.5% while Cheryl, Sianna, Montoya, and Jiang (2016) noted elements including masculine cultures that indicate a poorer sense of belonging for women than males, a lack of enough timely exposure to engineering, computerized sciences and physics, and gender discrepancies in self-efficacy in men's favor.They also concluded that gender inequalities in physics, engineering, and in interest in computer science already exist before college. These studies however investigated factors that explain participation in STEM while the current research investigated gender as a determinant in participation in science fairs.

In order to fairly understand the point of view and experiences of minority US students interested in STEM, Kricorian, Seu, Lopez, Ureta, and Equils (2020) conducted study on the factors impacting involvement of underrepresented students in STEM areas. Their main goal was to learn more about their mentorship experiences and preferences for having mentors who are of a similar gender and ethnicity. The family factor, academic mindsets, and perceptions toward STEM were among the factors examined in the USA that may have influenced individuals' choice to pursue a STEM-related field of study. In their findings, majority of participants (68 percent of the total participants) stressed the value of networking with and receiving STEM mentoring from people of the same gender and ethnicity, either personally or through media. In their study, this seemed to work against women as they observed that women in STEM are fewer than men. Their study was generally on STEM subjects while the current study narrows down to participation in science fair.

Lakin, Ewald, Hardy, Cobine, Marino, Landers & Davis (2021) observed that minority students and students from low-resource schools did not have the same opportunities to participate in significant S&E fair experiences and to take advantage of the opportunities these fairs present for

success, recognition, and even scholarships. This is in line with other research that contends that socioeconomic status may be related to both student project quality and school participation in S&E fairs (Grinnell et al., 2020; Kook, DeLisi, Fields &Levy, 2020; Korkmaz, 2012; McComas, 2011). Their studies were however done in Alabama while the current was done in Kenya.

Due to their limited access to resources such as money, real estate, education, and technology in India, women have a tough time pursuing careers in science (Beura) (2017). He lists gender biases, a lack of female role models, and issues balancing work and personal obligations as some of the main obstacles preventing women from participating in scientific endeavors. He further asserted that gender biases perpetuate the deplorable notion that women are less gifted and inclined in the fields of technology and science. Additionally, neither political nor economic influence favors a significant role for women in the sciences and in technology. Beura (2017) however generalised his study to science education and research while the current study specialized on science fairs.

Mupezeni & Kriek (2018) identified factors responsible for gender differences in boys and girls participation in science fairs in South Africa, as including inadequate learning facilities, lack of enough support from teachers and administration, few role models, insufficient equipment, few computers, and computer illiteracy. Factors such as schools' facilities, available mentors, available computers and computer literacy worked in favor of students from urban schools. Their study was however a comparison of science fair experiences between participants in rural schools and those in urban schools while the current is on gender as a determinant of participation in science fair.

In the study carried out by Campion, & Shrum (2004) in Ghana, Kenya and India, they argued that gender disparities in research systems of developing nations can be specifically linked to conventional familial responsibilities. The roles of "wife" and "mother" are typically viewed in

terms of the specified activities and role connections connected with their fulfillment; these roles are particularly strong in developing countries. This hence directly influenced participation in science and technology. They claimed that travel and educational restrictions together severely hinder women's access to professional networks in key ways. However, they come to the conclusion that there aren't many variations between women and men in the matter educational and personal background, professional responsibilities in terms of the work they do, engagement in professional affairs, productivity in research, and professional networks. These researchers however got respondents from career scientists while the current study got them from secondary school students. And science teachers.

2.4 Gender Responsive Strategies that can ensure Gender Equitable Participation in Science Fair Competitions

By fostering circumstances that attract and enable access for them to the field, women can be encouraged to engage in science-related activities (UNESCO, 2021). To address the worldwide difficulties facing women in science, international institutions like IAP and ISC that bring together national science bodies are required to mobilize international science (GenderInSITE, 2021). They also recommend need to create awareness of their existence and work closely with bodies like CEMASTEA to realize gender equitable participation in science. However, these recommendations are general of women' participation in science while the current study sought specific strategies for participation in science fairs.

Cheryl, Sianna, Montoya, & Jiang (2016) argue that changes to masculine cultures and the provision of students with early experiences that indicate equality to both girls and boys may help efforts to expand the participation of women in computer science, engineering, and physics in the US. Cheryan, Plaut, Davies, & Steele (2009) suggest that exposing learners to environment that is

not considered stereotypical of a certain gender can boost participation of both girls and boys in all subjects including the science field. These studies were done in USA and hence the strategies may only be applicable in USA and not in Kenya, where the current research was based.

Agufana (2015) while evaluating the implication of science and technology congress in Kenya on the development of biological education highlighted strategies that can promote equality in participation of girls and boys in science fair to include offering of career guidance to both girls and boys especially concerning science and also engagement of both girls and boys on equal issues pertaining science projects. His study was done in Nairobi and only dealt with science fairs in mixed secondary schools while the current one was conducted in Thika-west and involved all categories of secondary schools.

2.5 KNOWLEDGE GAP

The literature study demonstrates unequivocally that boys continue to predominate science fair competitions as well as the science field and that the ratio of secondary school girls participating is quite low. (Beura, 2017; Jones, 1991; Korkmaz, 2012; Greenfield, 1995 and Adamson et, al 1998). With the except of Sonnert, Sadler, & Michaels (2013) who reported an equality in the number of females and male participating. Most of these studies have however been carried out outside Africa yet Africa is among the continents with the highest gender gap in participation in science (Kimani, & Mwikamba, 2010; UNESCO, 2021). Besides, in Kenyan context, most of the scholarly work has only leaned on performance of STEM subjects at the classroom level, for example, Kimani & Mwikamba, 2010; Akala, 2010; Nyongesa,2014; Kimani, 2010; Mbirianjau, 2009) yet sciences are by nature practical. Based on these gaps, the researcher studied Gender as a Determinant of Students' Participation Levels in Science Fair Competitions in Secondary Schools in Thika-west sub-county, Kiambu, Kenya.

2.6 THEORETICAL FRAMEWORK

The social role theory developed by Eagly, & Wood (2012) was this study's guiding principle. At the core of the theory are societal stereotypes about gender. They contend that gender role views, which in turn reflect people's opinions of men's and women's social roles in the society in which they live, are reflected in sex differences and behavioral similarities. Due to these gender stereotypes of what women and men can and/or cannot do, there emerge informal reservation of some professions for a specific gender. For instance, fund managers, engineers, scientists and drivers are mainly perceived as males whereas females are perceived to fit best as nurses, preschool instructors and elementary school teachers (Kulkarni, & Hatekar, 2013).

This theory was therefore used to explain gender discrepancies in the number of girls and boys participating in science fair, in addition to explaining gender differences in choice of science projects to be undertaken. Science has been considered a masculine subject (Beura, 2017) and therefore this may explain why more boys than girls feature in science fair. Additionally, boys are seen to have an advantage in physics due to informal information they have acquired through out-of-class activities as the society expects boys to get more involved in wiring and tinkering than girls should (Lawton, & Bordens, 1995). This may explain boys' preference for physics projects compared to girls.

The theory was similarly used to explain why science teachers may prefer to work with boys rather than girls in preparation of science projects. This is so because science teachers are members of the society too- the society that socializes its people for these sex-typical role. This gives shape to gender biased selection processes by schools for representation of girls and boys in scientific fairs, and in essence affects the participation of boys and girls in science fairs.

Again, as a result of this gender bias of what men and women can or cannot do, girls wishing to participate in science fair may lack enough role models to look up to as the girls before them may have been similarly meant to believe that science is a man's thing. As a result, participation of boys and girls in science fairs and generally in science is affected. This can also account for other aspects responsible for gender disparity in the participation in science fairs, such as gender ideologies and stereotyping. This is more so for girls who as they try to shine in science fairs, will be invading a field traditionally reserved for men and boys and may therefore face resistance, spoken or implied.

Additionally, the theory was used to offer gender responsive strategies in science fair competitions for example creation of awareness to media to portray both girls and boys in diverse roles especially in science; and in all other fields traditionally reserved for men and boys. Tenets of the theory can also be useful in guiding teachers and the people involved in career guidance of students to fully involve both girls and boys in diverse career guidance especially in science careers as well as help teachers and other professionals who deal with students to engage both girls and boys on equal issues specially to do with science projects.

2.7 CONCEPTUAL FRAMEWORK

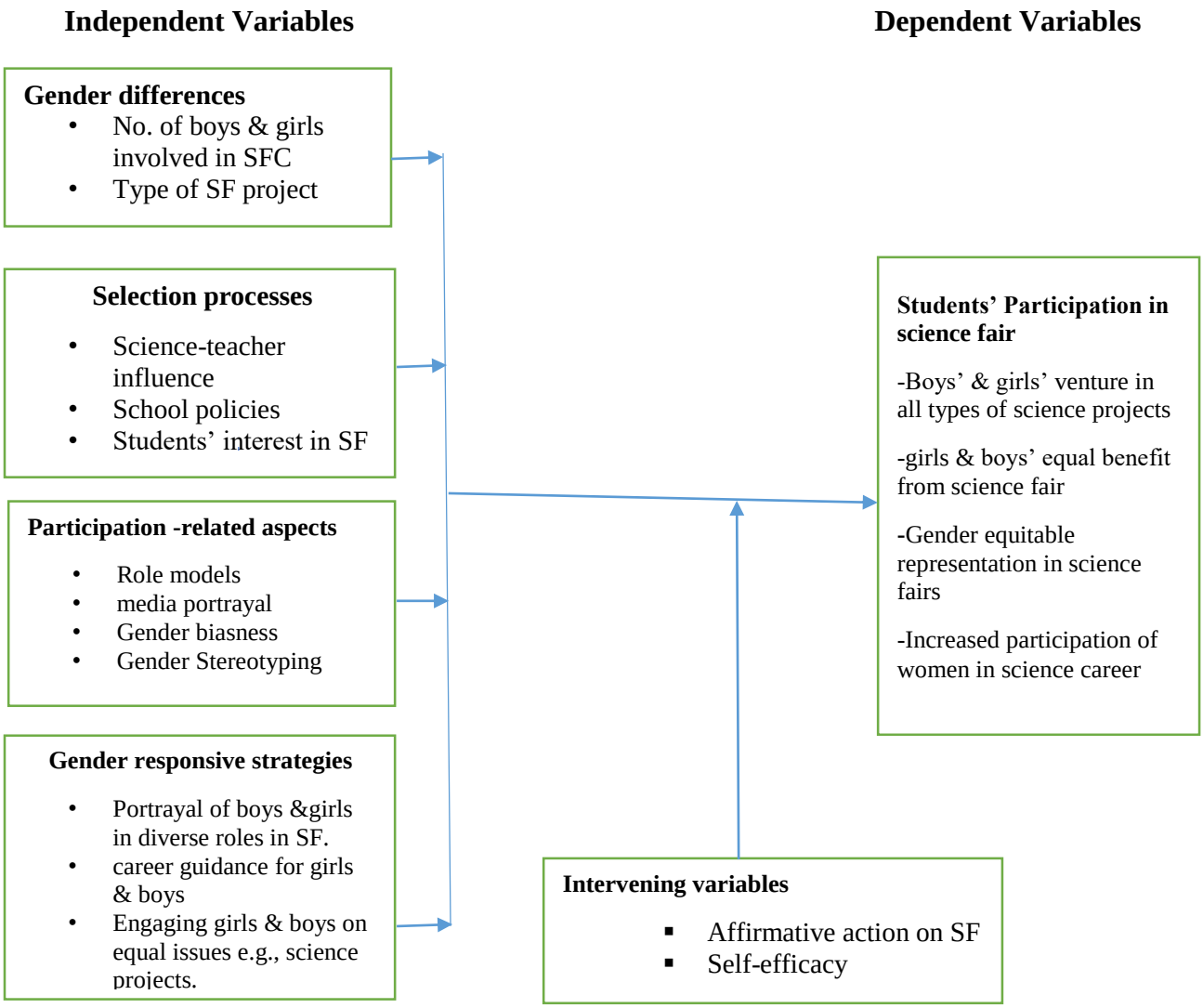


Figure 2.1 conceptual framework

The conceptual framework shows how the independent variables, intervening variables, and dependent variable interact. The independent variables include gender differences in the involvement in science fair with consideration to the number of girls and boys involved in science fair and also the kind of projects they undertake; participation-related aspects which comprise

available role models, media portrayal, gender biasness and gender stereotyping. It also comprises selection processes for representation in science fairs such as science-teacher influence, school policies and students' interest in science fair. The other independent variables are gender responsive strategies in science fair which comprise portrayal of boys and girls in diverse roles in science fair, career guidance for girls and boys; and engaging girls and boys equally especially in scientific issues.

The intervening variables will be affirmative action and students' self-efficacy. Though they are not part of the study, these variables may affect the study one way or the other.

Students' participation in science fair competitions is the dependent variable. It depends on the independent variables to achieve boys' & girls' venturing in all types of science projects, girls & boys' equally benefitting from science fair, achievement of gender equitable representation in science fairs and women's increased participation in science careers (fig 2.1).

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 INTRODUCTION

This chapter captures the research methodology highlighting the research design, variables, and site of the study, target population, sample size determination and sampling technique, research instruments, pretesting / piloting of study, validity and reliability. It further highlights data analysis and presentation techniques; and logical and ethical consideration.

3.1 RESEARCH DESIGN

This study adopted descriptive approach to collect both quantitative and qualitative data. According to Orodho (2005), descriptive survey designs can be used to gather data on people's attitudes, beliefs, habits, or any number of educational and societal issues. Participation in science fairs has a lot to do with people's attitudes, opinions and perception of things, making it appropriate to use this research design. Bhasin (2019) identifies some of the advantages of using the descriptive survey design as that it offers possibility of collecting data from a large population and that variety of data can be obtained using this research design. It is also cheap and quick to conduct since one does not require having a great space dedicated only to research.

3.2 VARIABLES

The dependent variable in this study was students' participation levels in science fair competition. The independent variables were gender differences in participation in science fair, selection processes in schools for representation in science fair competitions, participation-related aspects affecting participation in science fair competitions, and gender responsive strategies that promote

participation science fair. The intervening variables were students' self-efficacy and affirmative action in science fairs.

3.3 SITE OF THE STUDY

The study was conducted in schools in Thika-West sub-county, Kiambu County which is in the central part of Kenya. Thika west sub-county has a total of 22 secondary schools; 3 nationals, 3 extra county, 1 county and the remaining are sub-county schools. These comprise public and private schools; day and boarding schools, mixed and single sex schools as well as special schools. The total student population is around 18723 (MOE, Kiambu, 2021). It is therefore clear that this subcounty has a variety of secondary schools and diverse students and teachers hence findings of this study are highly representative.

Additionally, academically, this sub-county is among the best as far as KCSE performance is concerned. For instance, in the year 2019 it emerged position 2 out of 9 sub counties in the county, while in 2020 it was the best (MOE, Kiambu,2019, 2020). This suggests that students in this sub-county are academically good.

As far as science fair is concerned, this sub-county is known to host several science fair competitions. For instance, in the years 2016 and 2019, it hosted competitions at the regional level (Nova Pioneer Kenya, 2019, October 9th). This portrays adequate exposure to science projects and activities.

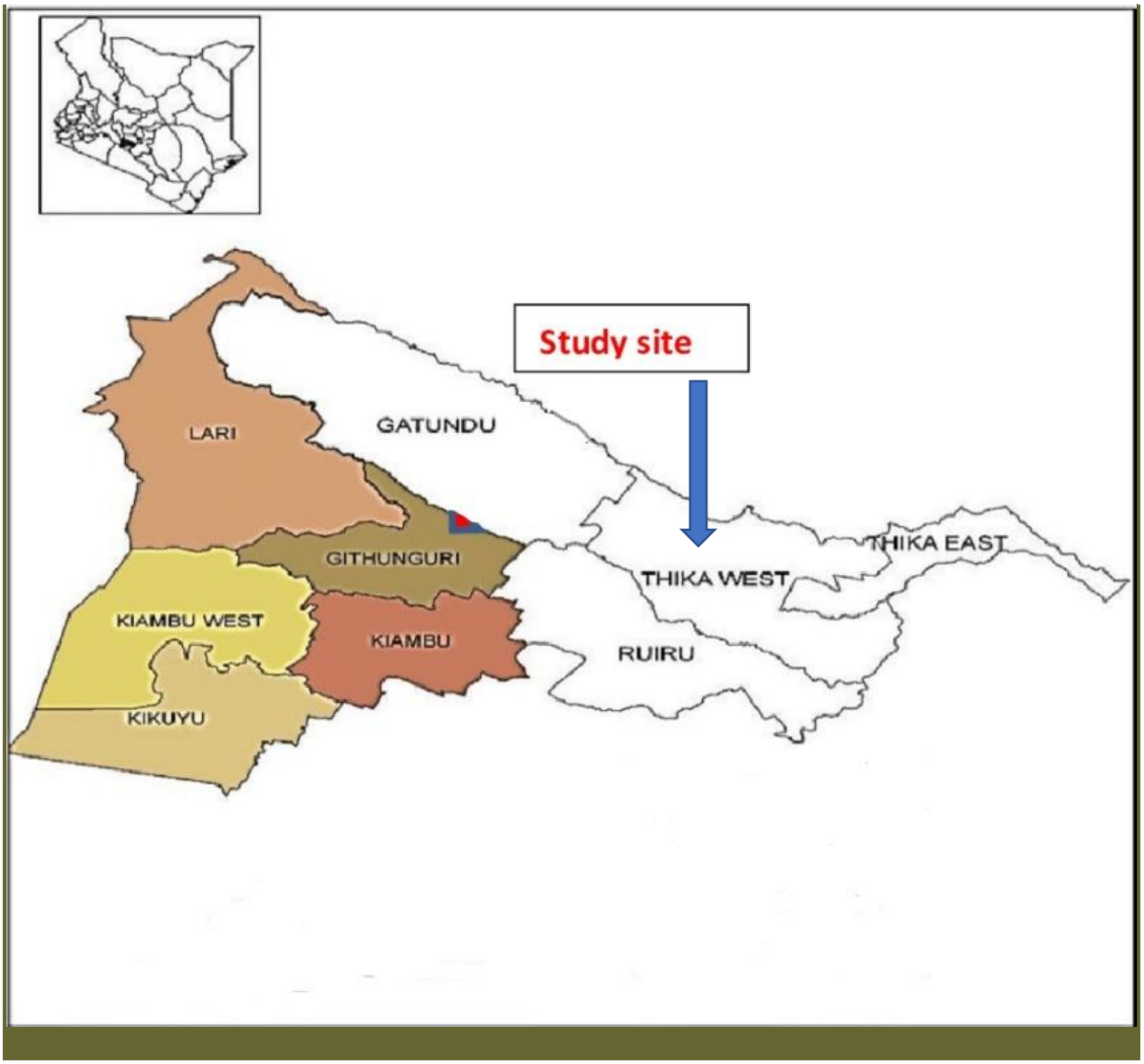


Figure 3.1: map of Kiambu county indicating site of study

Source: IEBC, 2017

3.4 TARGET POPULATION

The study targeted students and science teachers in the 5 purposively sampled secondary schools in Thika-west sub-county that consistently participated in science fair competitions between 2012-

2021.This consisted 3183 boys and girls; and 53 science teachers, male and female. Thus, the study targeted a total of 3236 respondents. Secondary school girls and boys were included in the study because in the Kenyan set-up, science fairs are majorly undertaken in secondary schools hence these boys and girls provided useful information on gender as a determinant of participation in science fairs. Furthermore, it targeted students who are members of science-oriented clubs such as science clubs, mathematics clubs and physics club for they are more likely to have more interest in science fairs than the rest. The science teachers on the other hand were chosen as they are directly involved in the planning and guiding of the students in science fairs. Besides, science fair judges are chosen from science teachers and hence they were expected to provide useful information regarding participation of students in science fairs.

3.5 SAMPLE SIZE DETERMINATION AND SAMPLING TECHNIQUE

The unit of analysis in this sub-section comprised sampling of the locale (county and the sub-county), sampling of the schools in that sub-county, and then sampling of students and science teachers from the identified schools and selection of science teachers from the selected schools. The sampling techniques and sample size in the study were as explained below;

3.5.1 Sampling technique for locale

Out of 47 counties in Kenya, Kiambu County was sampled using multistage sampling technique and the study employed purposive sampling method. Targets for purposive sampling method are reliable people for the study (Kombo, & Tromp, 2006). First, the counties were grouped according to their average academic performance from between 2012 and 2021. This is because participation in science fair by some degree requires cognitive skills (Lin, Yen, Liang, Chiu and Guo, 2016) which can be measured through academic performance. Secondly, they were grouped according

to the number of national schools they host. More than all category of schools, national schools draw students and teachers from all over the country (MOE, 2021). This was expected to enhance the representativeness of the findings of this study. On average, Kiambu County had maintained the first position academically from 2012 to 2021 and had the highest number of national schools - 8 in total (MOE, 2021). Therefore, this made Kiambu County the most ideal county for this study.

The county has a total of 9 sub-counties namely Lari, Gatundu, Kiambu-west, Kikuyu, Githunguri, Kiambu, Thika-west, Thika-east and Ruiru. The study picked 10% of this population translating to one sub-county. Oso, & Onen (2005) argue that 10% of the population in research is representative. The study then used simple random sampling technique to arrive at Thika west sub-county. Names of all the 9 sub-counties were put down on pieces of paper and placed in a basket. One piece of the paper was then randomly picked from the basket. In simple random sampling technique, the researcher randomly selects a sub-set of participants from a population and every sub-set has equal chances of being picked (Thomas, 2020). It has the advantage of removing all hints of bias and hence it was suitable in the sampling of the sub-county in this study.

3.5.2 Sampling Technique for Schools

The study used purposive sampling method to select only secondary schools that have consistently participated in science fair in the years between 2012 and 2021. According to Etikin, Musa, & Alkassim (2016) a respondent who chooses to participate in research on purpose does so because of certain characteristics he or she possesses. Between the years 2012 and 2021, schools that consistently participated in science fairs in Thika-west sub-county are 15 (appendix 4) out of 22 (Thika-west science fair committee, 2021).

After arriving at 15 schools, the study then employed multistage sampling and stratified random sampling methods to select the schools. Firstly, the study grouped the schools in strata of national, extra-county, county and sub-county schools. The 15 schools arrived at fit in the strata allocated as following: 3 national schools, 3 extra county schools, 1 county school and 8 sub-county schools. According to Mugenda &Mugenda (2013) sample size determination, the study selected 5 schools, a 33.3% representation. These schools are namely; S.A. Thika national school for the physically challenged (mixed), Thika High School which is an extra-county boy only school, Karibaribi Girls which is a county and girl only school, Broadway Mixed Secondary and Queen of Rosary Mixed secondary School. Secondly, it embarked on identifying the number of schools needed in each stratum. The number of schools in each stratum were distributed using Kothari (2013) proportional allocation technique as follows: ni = n*pi, where ni = the size of the strata, n = the sample size and pi = the proportion of population included in the stratum, For example,

For national schools, the number of the schools selected were;

5*3/15= 1 school

The study then repeated the same process to get 1 extra-county school, 1 county school and 2 sub-county schools; totalling to 5 schools.

In the national schools' strata, one special needs school was purposively sampled to represent special needs students. Of the two special needs schools (school for the blind and school for the physically challenged), School for the physically challenged was selected using simple random sampling, where the names of the two schools were written down and placed in a bag, then the researcher chose one at random. Sampling of the extra-county and sub-county schools was randomly done in a similar manner. One county school was purposely sampled as it was the only school in the stratum, based on non-proportional stratified random sampling method which

advocate for the inclusion of each population group in the sample in order to reduce estimation inaccuracy (Bryman & Bell, 2017).

3.5.3 Sampling Technique for Students and Science Teachers

The sample size for teachers and students was established using the Slovin's (1960) formulae. This is because the population targeted encompasses a sizable number (N=3236). A researcher can accurately sample the population using Slovin's formulae (Stephine, 2016). Based on Patino & Terreira's (2015), this study employed a 95% confidence level, which means that there were 95 possibilities in a hundred that the sample is representational of the population, compared to five chances in a hundred that it is not. The calculations were as below:

$$n = \frac{N}{1+N(e)^2}$$

Where n= sample size, N = population size, e = margin of error. Thus,

$$n = \frac{3236}{1+(3236*0.05*0.05)}$$

n = 356 participants

As a result, 356 respondents made up the entire sample from a target population of 3236 people, which is 11% representation. When the target population is less than 10,000, Mugenda & Mugenda (2013) observe that a sample size of 10% to 30% is considered well representing the targeted group. After getting 356 respondents, placement of students and science teachers to different strata used Kothari (2013) proportional allocation technique which is: ni = n*pi. Thus, the study had a sample size of 356 comprising 350 boys and girls in equal numbers and 6 male and female science teachers similarly in equal numbers.

The allocation of the number of boys and girls and male and female teachers from each school used the same formulae.

Thus, for national school, the population was;

$$ni = \frac{356*356}{3236}$$

=39 boys and girls

The formula was then used to get 108 boys from the extra-county school, 90 girls from the county school, 54 boys and girls from one of the sub-county schools and 59 from the other sub-county school; and then get 3 male and 3 female science teachers from the sampled schools. Equal number of boys and girls was obtained by balancing the numbers in mixed secondary schools. Overall, the sample size of boys and girls was therefore 150 for each.

3.5.4 Sampling Procedure for Selecting Science Teachers from various Schools

This still used Kothari's (2013) method of ni = n*pi to get 1 teacher from the national school, 2 teachers from the extra-county school and 1 teacher from each of the sub-county schools. The proportion of teachers selected from different sampled schools used systematic sampling technique whereby the researcher requested for lists of science teachers from the sampled schools. The researcher then used the formulae $^{N/}_{n}$ to obtain an integer that acted as a constant in the progression of the list between the two successive numbers. To obtain the sample size of science teachers who served as respondents in this study, the researcher repeated the procedure with the other lists. For example;

For national school, and the 2 sub-county schools which have a science teacher population of 9, it was as follows;

$^{9}/_{1}$ =9 the integer is 9

Therefore, the study picked the 1st teacher in the list. It then used the same formulae to pick the 1st and the 9th teachers in the extra county school and the 1st teacher for the county school. The study then used purposive sampling to get equal number of male and female teachers such that if the 9th teacher in the list was male and the study targeted a female, it targeted any following female teacher in the list.

The summary of sample size for boys and girls, and science teachers is as follows;

Table 3.1: Sampling of students and science teachers

Type of school	**Category**	**Total Population of students**	**sampled population of students**	**Total population of science teachers**	**Sampled population of science teachers**
National	School for the physically challenged	356	39	9	1
Extra-county	Boys only	989	108	15	2
County	Girls only	814	90	11	1
Sub-county	Mixed boys and girls	493	54	9	1
	Mixed boys and girls	531	59	9	1
		3183	350	53	6

Source of data on total populations is MOE, Kiambu County (2021)

3.6 RESEARCH INSTRUMENTS

The study used various instruments to get primary and secondary data. Questionnaires and structured interview schedules were used in collection of primary data. Questionnaires were issued to all selected students (appendix 1). Gall, Borg & Gall (2003) indicate that questionnaires are very effective since they give detailed answers to complex issues. They also give a relatively objective data and are time saving. Structured interview schedules which involved preparing all the

questions prior, and putting them in the same order for every interviewee were also used to collect information from the selected science teachers. Their advantage in that they provide reliable and valid results (Bell, 1991). Besides, they blend questioning, cross-examining, and probing approaches to enable multi-method data collecting (Owens, 2009). Secondary data was obtained from published books and e-journals on gender and science fairs.

3.7 PRE-TESTING/PILOTING STUDY

Piloting was done to assess the feasibility and effectiveness of the research design, methods and instruments. It was done to ensure that the instruments identified for use are valid and reliable for the study. Research instruments were tested and re-tested for validity and reliability in a few randomly selected schools in Nakuru-west sub-county. This county and sub-county was found best for pre-testing of the instruments since it carries lots of similarities with the study area and hence it is a good measure of correlation co-effici ency for the study.

3.7.1 VALIDITY

If a study is valid, it should measure the things intended to be measured (Kothari, 2011). The information chosen and included in a data collection tool must be pertinent to the defined requirement or gap in order to be accepted as valid. The researcher ensured validity of the instruments by stating questions objectively in the questionnaire and structured interview guides. As a result, complexity was avoided and the content was certain to address the desired answers. Sampling validity was obtained by carefully stating research objectives and questions. Construct validity was on the other hand achieved by operationalizing study variables and concepts to clearly show theoretical assumptions underpinning the conceptual framework for the study (Saunders, Lewis &Thornhill, 2003). Guidance of supervisors allocated to the researcher was also sought to

validate the questionnaires and structured interview guides.

3.7.2 RELIABILITY

Reliability is a measure of how consistently research tools yield results (Mugenda, & Mugenda, 2008). The study tools were tested and retested in Nakuru-west sub-county for reliability. The respondents were given the questionnaires and structured interview guides to ensure they are accurate, correct and meaningful.

3.8 DATA COLLECTION TECHNIQUES

Primary data was gotten by self-administration of questionnaires and structured interview guides conducted face to face by the researcher. Self-administered data collection methods make it possible to contact a lot of potential respondents quickly (Mugenda & Mugenda, 2008). Literature on gender in science and science fair was used to obtain secondary data.

3.9 DATA ANALYSIS AND PRESENTATION

Collected data was analyzed both quantitatively and qualitatively. Statistical Package for Social Sciences (SPSS) version 23 was used to analyze descriptive data from questionnaires and was used to present the data in tables with frequencies, counts and percentages; and figures with graphs and charts while data collected qualitatively through face-to-face interviews was analyzed using content analysis and presented in themes and verbatim.

3.10 LOGISTICAL AND ETHICAL CONSIDERATIONS

Madges (2006) argues that the definition of ethical research is "does not hurt," "gives informed consent," and "respects the rights of those being examined." The researcher did so by first seeking consent from Kenyatta University then sought research permit from NACOSTI and obtained a

permit from County Director of Education, Kiambu before embarking on collection of data from the field. It also sought consent from parents and guardians, through class teachers, before getting data from students who are below 18 years. The respondents were then informed of the nature and aim of the study in addition to making them aware that their responses would remain anonymous, hence they won't face any negative consequences connected to their responses. Besides, they were informed that participation is optional and that if they so choose, they were free to withhold their responses to any particular questions. This is in keeping with Trochim's (2006) contention that voluntary participation necessitates that study participants not be forced into taking part in the research. Clarifications on the purpose of the study was done prior. Signing of consent form to participate in the study voluntarily was then done. The respondents were also informed that in place of their actual names, pseudonyms would be used as a further step to guard their confidentiality. Lastly, by properly citing all the sources used in the study, the researcher prevented information fraud and plagiarism.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND DISCUSSION

4.0 Introduction

This chapter presents data analysis, presentation, interpretation and discussion on the findings from the study 'Gender as a Determinant of Students' Participation levels in Science Fair Competitions in Secondary Schools in Kiambu County, Kenya.' The data was analyzed with the help of a computer program, SPSS version 23. This enabled the descriptive data to be presented in tables containing frequencies, percentages and counts; and figures with charts and graphs while qualitative data was presented in themes and verbatim and analyzed using content analysis. The chapter also presents the results of the study based on the research objectives that guided the study and included: quantitatively establish gender differences in the number of boys and girls involved in selected science fair competitions in secondary schools in Kiambu county from 2012 to 2021, examine the criteria and procedures used in the selection of students by gender for science fair competitions in secondary schools in Thika-west sub-county, identify and assess key aspects that affect the participation of boys and girls in science fair competitions in secondary schools in Thika west sub-county and propose gender responsive strategies aimed at promoting equitable participation of boys and girls in science fair competitions in secondary schools in Thika-west sub-county-Kiambu.

4.1 Response Rate

The study sought to establish the distribution of respondents and their response rate which was as follows;

Table 4.1: Response Rate by Respondents

Category	Sample Size	Respondents	percentage
Girls	175	171	97.7%
Boys	175	173	98.9%
Male science teachers	3	4	133.3%
Female science teachers	3	2	66.7%%
Total	**356**	**350**	**98.3%**

Source: Selected Secondary Schools in Thika-west sub-county (2022)

A total of 175 boys and 175 girls; and 3 male science teachers and 3 female science teachers were selected from five secondary schools in Thika-west sub-county to participate in the study. During the study period, a total of 350 questionnaires were administered to the boys and girls while 3 male science teachers and 3 female science teachers were exposed to structured interview guides. Out of the questionnaires administered, 344 were returned (173 from the boys and 171 from the girls) in addition to the 6 interview guides (2 from the female science teachers and 4 from the male science teachers). This was a representation rate of 97.7% of the girls and 98.9% of the boys expected to participate, an average representation of 98.3% of the students. As for the male science teachers, a representation of 133.7% of the teachers were interviewed while 66.7% of the female science teachers were also interviewed as indicated in table 4.1. Initially, the study targeted 3 science teachers from each gender but ended with 4

male ones and 2 female ones. This was occasioned by the smaller number of female science teachers in the sub-county coupled with unwillingness of female science teachers to participate in the study. The total study response therefore comprised 350 respondents; an overall response rate of 98.3% which was adequate to produce the desired outcome.

4.2 Demographic Information of Respondents

4.2.1: Introduction

The general background details of the two kinds of respondents—science teachers and students—are covered in this section. The background characteristics of students included gender, type of school, age and class while that of the science teachers included their gender and science subjects they teach. A summary of the sub-section was also established.

4.2.2: Distribution of Boy and Girl Respondents by School and Gender

Students' distribution by school and gender was established to know how many boys and girls participated in the study and from which school they came. This was useful as different schools have different policies that can determine girls' and boys' participation in science fair and again it was useful to capture the responses of variety of students from different schools. Besides, participation in science fair can be determined by the gender of the students as concluded by earlier studies such as the one by Thornton (2019). The research established the data to be as presented in table 4.2

Table 4.2: Distribution of Boys and Girls by School and Gender

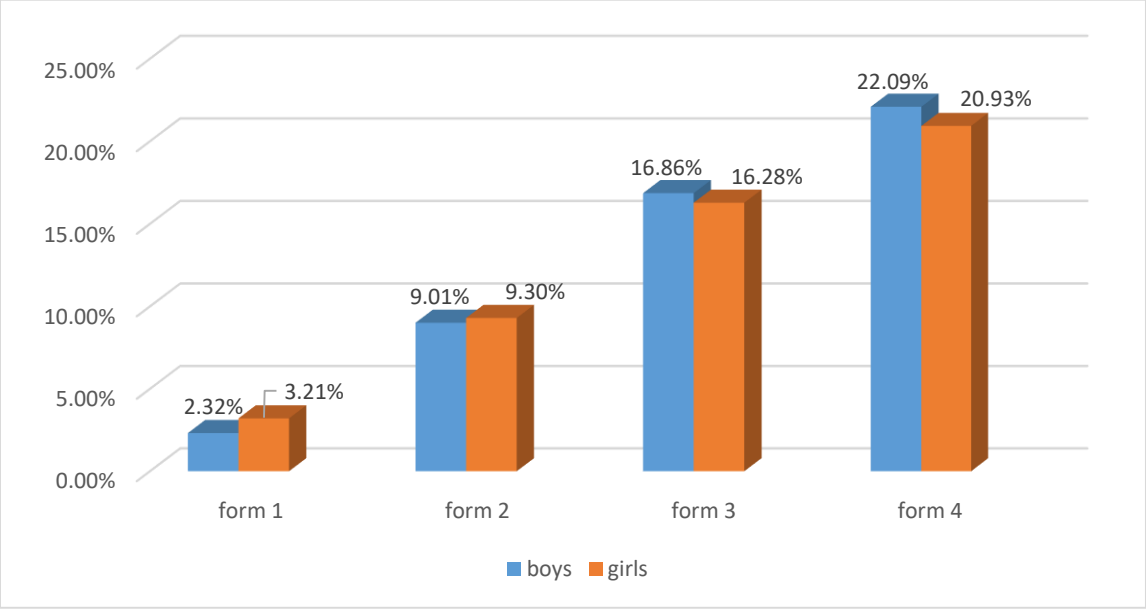
Kind of school	Girls involved		Boys involved		overall	
	N	%	N	%	N	%
National, special, mixed boarding	21	53.8	18	46.2	39	11.3
Extra-county, mainstream boys' boarding	0	0	104	100	104	30.2
County, mainstream, girls boarding	88	100	0	0	88	25.6
Sub-county, mainstream mixed day	34	63.0	20	39.0	54	15.7
Sub-county, mainstream mixed day	28	47.5	31	52.5	59	17.2
TOTAL	**171**	**49.7**	**173**	**50.3**	**344**	**100**

Out of the 344 students who participated in the study, 173 were boys, a representation of 50.3% while girls were 171 (49.7%) as indicated in table 4.2.1. Initially, the research had wished to work with equal representation of boys and girls, that is, 175 for each gender but ended with a slightly higher number of boys (50.30%) compared to girls (49.70%). This was occasioned by the state whereby more boys than girls were willing to participate in the study. On the other hand, all the categories of schools participated as anticipated by the researcher. It however emerged that findings of the study were not greatly affected by the kind of school the respondents came from as responses were relatively similar and different per gender of student as compared to per the kind of school. Therefore, gender of the students turned out to be one of the determining factors in participation in science fair in the study area.

4.2.3: Distribution of Boy and Girl Respondents by their Class

The classes of the boys and girls who participated in the study was also established. This was important since boys and girls in different classes have different exposure to scientific knowledge and science fairs. The classes of the student respondents were as summarised in figure 4.2.1 below:

Figure 4.2.1: Distribution of boy and girl respondents by class



Source: Selected Secondary Schools in Thika-west sub-county (2022)

In the study, there was high participation of boys and girls in form 3 (114 students) which is 33.20% and form 4 (148 students) which is 43.00% compared to form 1(19 students) at 5.50% participation rate and form 2 (63 students) at 18.30%. In form 1 and 2, the participation of girls was more than that of the boys at 11 (3.21%) against 8 (2.32%) that of the boys in form 1; and 32 girls against 31 boys in form 2. However, in form 3 and form 4, boys were more at 16.86% (58 boys) against 16.28% girls in form 3; and 76 boys (22.09%) against 72 girls (20.93%). Overall, the number of boys in form 3 and 4 was higher than the rest. This points at gender differences and suggests that boys become serious in science fairs up the class levels compared to girls. Therefore, gender differences in participation of the respondents at class level were witnessed. This is more so because priority of participation was given to members of the science-related clubs.

4.2.4: Distribution by age of participating boys and girls

The age of the participating students was established. This was important since the age of boys and girls is a key determinant to whether they have made up their minds concerning their future career. Older students are more likely than the younger ones to have settled on certain careers such as careers in sciences. Students with careers in sciences are more likely than the rest to participate in science fairs. The age of the student respondents was as summarised in the following table 4.2.2:

Table 4.2.2: Age of Participating Boys and Girls

Age in years	**Boys involved**		**Girls involved**		**Overall**	
	Number	Percent	Number	Percent	Number	Percent
15	6	1.8	6	1.8	12	3.5
16	42	12.2	46	13.4	88	25.6
17	71	20.6	68	19.8	139	40.4
18	49	14.3	49	14.3	98	28.5
19	5	1.5	2	0.6	7	2.0
TOTAL	**173**	**50.3**	**171**	**49.7**	**344**	**100**

Source: Selected Secondary schools in Thika-west sub-county (2022)

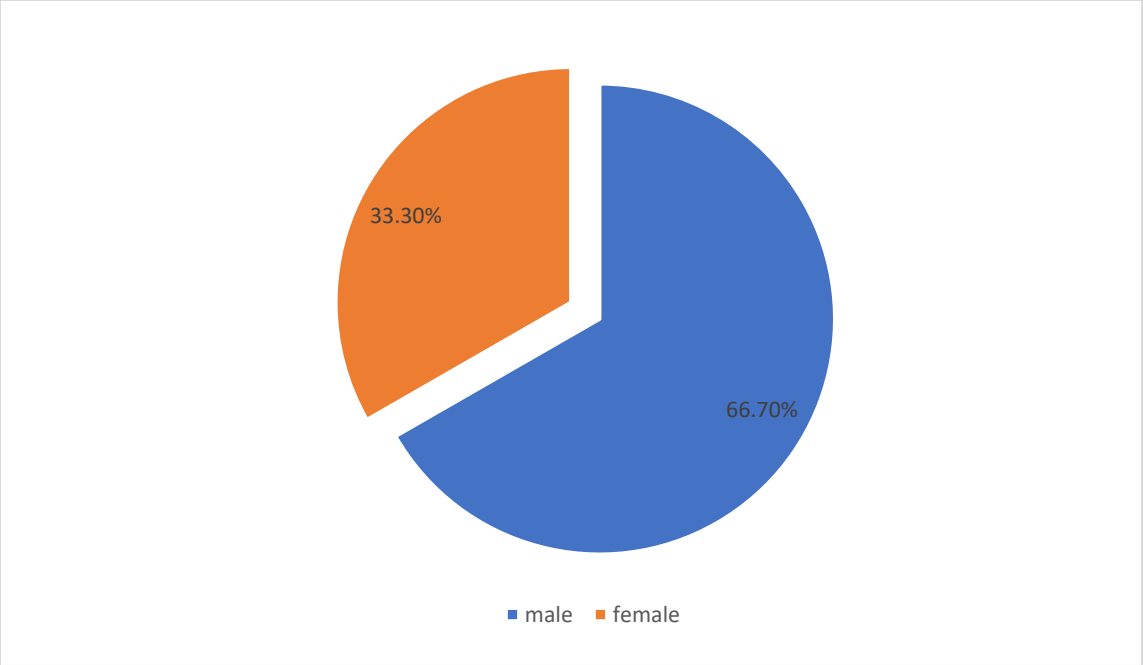
The researcher established that most boys and girls were between ages 17 (40.41%) and 18 years (28.49%). This might suggest a high maturity level of majority of the boys and girls involved, bearing in mind that these students were mainly in form 3 and form 4. There were no major differences between the boys and girls in these age brackets since there were equal number of boys and girls aged 18 (14.25%) while there was only a difference of 3 students between the boys and

girls in 17 years. It may also suggest that these are the students who had finally decided on their career paths and therefore participation in science fair for them was engineered by career paths. There was also a good representation by boys and girls who were 16 years (25.58%). Their number difference was also negligible. The fewest students were the ages 15 (3.49%) and age 19 (2.03%) were the difference in number between boys and girls was only 3. These are majorly students in form 1 and form 4 respectively. Generally, students in form 1, both boys and girls were fewer compared to those in the other classes. As for form four students, it was established that majority were in the 17 to 18 age brackets and only a few were above 18, which might explain the few 19-year-old girls and boys. The study therefore established that age of boys and girls does not directly determine their participation in science fair competitions in the area of study.

4.2.5: Distribution of science teachers by gender

Data on the gender of science teachers involved in the study was captured. It was important for the study to collect such data since previous studies by Amunga & Musasia (2020) had concluded that gender determines participation in sciences. Findings are as presented in the figure 4.2.2 below:

Figure 4.2.2: Gender distribution of science teachers



Out of 6 science teachers who participated in the study, 66.7% were male while the remaining 33.3% were female. This means that there was a higher participation of male science teachers as compared to female science teachers in secondary schools in Thika-west sub-county. This number was proportional to the total number of female and male science teachers in the sub-county (M.O.E. Kiambu County, 2022) which was marked by fewer female science teachers compared to male science ones. The gender distribution in the study therefore reflects male dominance in the science field as observed by Steegh (2021) in his study where he found out that the males in the science field in USA are more than half of the total population in the field. UNESCO (2021) similarly placed women involved in science and research at only 30% globally and as low as 28% in Kenya. Science teachers are key in promotion of scientific ideas and research and there is therefore need to have both men and women equally represented in the teaching and in general participation in sciences.

4.2.6: Distribution of male and female science teachers by subjects taught

Data on the subjects taught by the male and female science teachers who participated in the research was taken. This would help establish what science subjects the boys and girls had an opportunity to study in school. The more science subjects available in school also would determine the opportunities to participate in many different science fairs, since science projects are affiliated to various science subjects. Table 4.2.3 shows that distribution.

Table 4.2.3: Science subjects taught by male and female science teacher respondents

subjects taught	males involved	females involved	Total
Chemistry	2	1	3
physics	2	0	2
biology	2	1	3
mathematics	2	1	3
home science	0	1	1
Total	**4**	**2**	**6**

Source: Selected Secondary Schools in Thika-west sub-county (2022)

The 6 science teachers taught different science subjects. Each secondary school teacher in Kenya is expected to have two teaching subjects which are examinable by Kenya National Examination Council (TSC, 2021). Therefore, with respect to this, the study found out that 2 of the teachers, both male, taught chemistry and biology, 1 who was female taught chemistry and mathematics, another female taught biology and home science while the last 2, both males, taught mathematics and physics, as indicated in table 4.2.3. None of the male teachers interviewed taught home science and likewise none of the female teachers taught physics. This was important for the research since most of the major science subjects were represented by teachers and hence the findings

representative as far as different sciences are concerned. Therefore, data on science subjects taught by science teachers involved in the study was important in determining the participation of boys and girls in science fair competitions. It however did not escape the research that there are gender differences in the choice of subjects taught by various male and female teachers, since the study did not find a single male teacher teaching home science; nor a female teacher teaching physics. This agrees with the study by Beura (2017) who found out that most males preferred working on technical subjects like physics while females preferred biological and home science.

4.2.7: Summary of the Demographic Characteristics of the Respondents

In summary, the population dynamics of the respondents in the study was suitable to produce desired outcome. Gender and class level of the student respondents were seen to determine their participation in science fairs. In this note, boy participants were slightly more than girls at 50.3% against girls' 49.7% as indicated in table 4.2.1. As far as class level was concerned, senior students in form 3 and form 4 participated in the study more than those in form 1 and form 2. Bearing in mind that the research gave priority to students affiliated to science clubs, it is arguable that most students in science clubs are in form 3 and form 4. For the study, this means that most senior students had settled in career field and hence those with careers in science are more likely to have joined science related clubs, leading to their higher participation in science fairs. Gender similarly determined the participation of the science teachers in the study. It was established that majority of the participating science teachers were male at 66.67% against females' 33.33%. this was linked to the smaller number of female teachers in the area of study (M.O.E. Kiambu County, 2022). Data on the subjects taught by the teachers involved in the study was useful as it helped the study establish that most the major subjects of study were represented. Science fair projects lean on various subjects studied in secondary schools. In summary, boys and male teachers who

participated in the study were more than their counterpart girls and female teachers. This implies a gender gap in respondents' participation in the research and was occasioned by factors such as respondents' willingness to participate in the research and the small number of female teachers teaching science subjects in the sub-county (M.O.E, Kiambu, 2022).

4.3 Gender Differences in Participation in Science Fair Competitions

4.3.1 Introduction

This section addresses the first objective of the study which sought to establish gender differences in the number of boys and girls involved in science fair competitions. It was examined through the questionnaires presented to the selected students and structured interviews with selected science teachers. The section is made up of 4 sub-sections: number of boys and girls involved in science fair, projects selected, level of competition reached, and a summary of the section.

4.3.2 Number of Boys and Girls involved in Science Fair Competitions.

The number of boys and girls involved in science fair was arrived at by asking the questionnaire respondents to mention the kind of students who participate in science fair and also to comment on how many girls as compared to boys participate in science fair in their school or subcounty. The interviewed respondents (science teachers) were on the other hand asked about their opinion concerning boys' and girls' participation in science fair.

The responses were alike and divergent with regard to the gender of the respondents such that girls as a group seemed to hold a certain opinion while boys as a group seemed to hold their own opinion.

The following table summarises the information on the number of boys and girls involved in science fair competitions as reported in various types of schools:

Table 4.3: Proportion of boys and girls involved in Science Fairs

Type of school	Boys involved		Girls involved		Total	
	N	**%**	**N**	**%**	**N**	**%**
Two mixed schools	126	83	26	17	152	100
Boys' school	94	90	10	10	104	100
Girls' school	46	52	42	48	88	100
Total	**266**	**77**	**78**	**33**	**344**	**100**

Source: Selected Secondary Schools in Thika-west sub-county (2022)

As indicated in table 4.3, various students had various answers concerning the number of boys and girls participating in science fair. It is easy to note that responses on the number of boys involved in science fair is highest in the boys' only school at 94%, followed by the mixed schools at 83% and lowest in the girls only school. The girls' only school reported the highest number of perceived girls' participation in science fair competitions, at 42%, which is still lower than the perceived number of boys at 52%. It is worth to note that on average, schools reported that the participation of boys in science fair is higher, at 77% compared to that of the girls at 33%. This presents a gender gap in participation in science fair. Much as the Ministry of Education Science and Technology (MOEST) has persistently underscored the importance of co-curricular activities, including science fairs, in secondary schools in Kenya (Ndunguri, 2017), and have therefore opened

participation for all students irrespective of their age, gender, school or religion, the involvement of boys and girls in science fair in Thika-west sub-county is skewed towards boys since fewer girls were seen to participate. The study therefore found gender differences in the number of boys and girls involved in science fair competitions.

As for the 6 science teachers interviewed, 4 (66.7%) agreed that boys' participation in science fair competitions is more than that of the girls, while 33.3% (2) felt that girls and boys participate in science fair by equal numbers. No teacher felt that the participation of girls is higher than that of boys.

Findings of this study therefore agree with those of the studies by Beura (2017) who found out that in India, the representation of boys in science is higher than that of the girls. Steegh (2021) had similarly found higher numbers of boys participating in science fair in USA compared to girls. Gender gap in the number of boys and girls participating in science fairs in Thika-west sub-county may therefore contribute to gender differences in participation in science.

4.3.3: Science Fair Projects selected by Boys and Girls

The respondents were asked to state the kind of projects most students in their schools undertake. Most respondents felt that there were no major differences in the kind of projects selected, and that girls as well as boys can comfortably deal with any project. This is as indicated in table 4.3.2:

Table 4.3.2: Science Fair projects selected by boys and girls

Projects mostly selected	**Boys involved**		**Girls involved**	
	Number	Percent	Number	Percent
All sciences	116	67.1	113	66.1
Chemistry	14	8.1	12	7.0
Physics	14	8.1	10	5.9
Mathematics	14	8.1	14	8.2
Biology	12	6.9	12	7.0
Home sciences	3	1.7	10	5.9
TOTAL	**173**	**100.0**	**171**	**100.0**

Source: Selected Secondary Schools in Thika-west sub-county (2022)

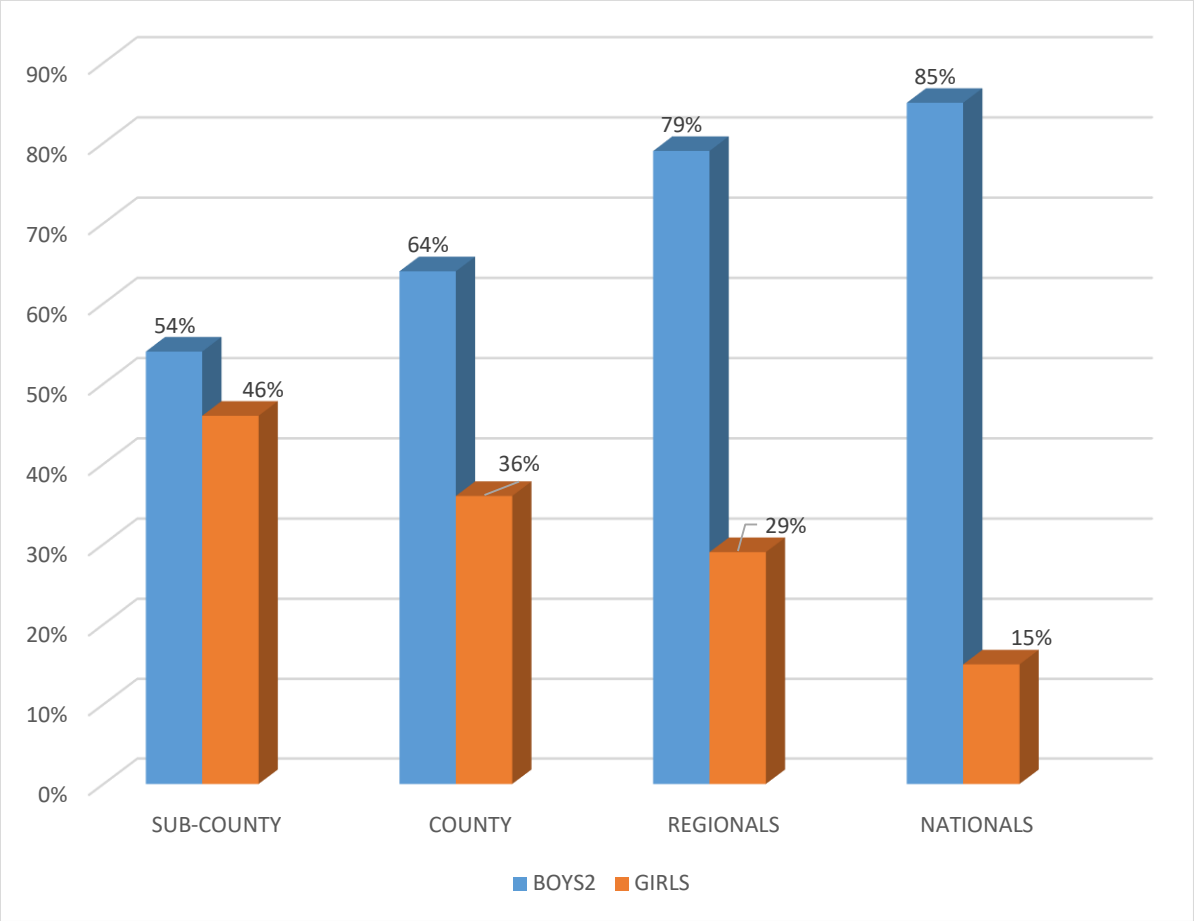
As discussed in table 4.3.2, majority of the respondents (67.05% of boys and 66.08% of girls) indicated that boys and girls in their schools and sub-county have no problem tackling any science project and hence any student, irrespective of their gender, can tackle science projects leaning to any science subject. It however emerged that more girls (5.85%) than boys (1.74%) preferred home science projects, indicating that indeed there are gender differences in the choice of the projects. For projects leaning on the other subjects, the differences appeared minimal. This suggests positivity on the side of the students towards participation in any kind of projects. Going by the responses of the girls particularly, it is easy to conclude what Gasant (2011) concluded that 'While the stereotype of a scientist as a man is still prevalent, some girls are challenging it and speaking out just as forcefully as boys.'

Findings of this study therefore are contrary to studies by korkmax (2012) and Greenfield (1995) who found out that boys tended to choose physics projects and girls biological projects. However, the responses of student respondents differed with those of the majority of science teacher respondents (66.67%) who felt that boys choose more technical and more challenging projects like energy and transport which lean on physics, whereas girls choose simpler projects such as those associated with home economics and lean on biology and home sciences.

4.3.4: Levels of Participation Reached

Findings on the levels of participation reached in science fair competitions was established by asking the respondent the questions 'What is the highest level reached by your school in science fair between 2012 and 2021? Who reached that level?' The responses indicating the highest level reached by different school is as summarised in figure 4.3.1

Figure 4.3.1: Highest levels of participation reached in science fair between 2012 and 2021



Source: Selected Secondary Schools in Thika-west sub-county (2022)

As indicated in figure 4.3.1, the percentage of boys who participated in science fair between 2012 and 2021 was higher than that of the girls at all levels of competition. At the sub-county level, which is the lowest level of participation, boys who participated were 86 (54%) compared to girls who were 72 (46%). This presents gender differences in the level of competition reached, in favour of boys. Similarly, the number of boys compared to girls increased with rise in the levels of participation, while that of girls decreased. The percentage for boys moves to 64% (21 participants) against girls' 36% (12 participants) at the county level. At the regional and national levels, boys are at 79% (19 participants) and 85% (11 participants) respectively while girls are at 21% (5 participants) and 15% (2 participants) respectively. This suggests that boys perfect their projects

as the competition gets tougher as opposed to girls. The number of girls decrease with rise in the level of competition which implies that they get less chances to participate in more meaningful levels of science fair competitions and hence less exposure to scientific challenges. This might therefore be used to explain the gender gap in technical departments of science (UNESCO, 2018) which argued that in Africa, female scientists rarely work as research directors or Principal Investigators, rather, they work at junior posts, and that women tend to leave more senior scientific posts for their male counterparts. Akala (2010) argues that this gender gap is seen to roll back to school days where boys are reported to be more active in science than girls are. She also argues that the situation happens regularly such that it appears like the normalcy hence when girls and boys grow up, men and women are used to this gender gap in science and embrace it as the norm.

One of the interviewees, asked about her opinion on participation of boys and girls in science fairs in the sub-county said;

"Girls participating in science fairs in the sub-county are very few. Actually, we almost know that girls who bring quality projects only come from one school (the mainstream national school in the sub-county). Other girls bring very uncreative projects and they don't seem to care to improve. As for boys, irrespective of their school, most of their projects are logical and proceed to higher levels" (Interviewee and judge, Mrs Norman*).

Another said;

The only thing girls have in science fair is communication skills and confidence. Most of their projects are shallow, they don't go beyond the sub-county level. Boys may lack language but their projects speak volumes (interviewee, Mr John*).

These responses confirm that there are gender differences in the levels reached by boys and girls in science fair in the study locale. These differences seem to be in favour of boys where they were reported to produce more quality projects compared to girls, projects that are likely to proceed to higher levels of competition. The responses also clearly communicated biased portrayal of girls in science fair which might also account for the gender differences.

Findings of this study are in contrast with the study by Westbury (2017) which found out that boys and girls compete equally at all levels of science fair competitions and that equal number of boys and girls often reach the highest levels of competition.

4.3.5: Summary of Gender Differences in Boys' and Girls' Participation in Science Fair

From the findings discussed, the number of boys involved in science fair competitions in Thika-west sub-county is more than that of the girls. In addition, most boys were reported to engage themselves in more technical science fair projects such as those that deal with technological discoveries, engineering, energy and transport and lean on subjects such as computer, mathematics and physics. Most girls on the other hand were indicated to prefer less technical and less challenging projects especially environmental and behavioural projects which lean more on home science and biology. These findings therefore agree with studies by Greenfield (1995) in USA, Agufana (2015) in Nairobi, and Beura (2017) in India which found out that participation of boys in science fair was higher than that of girls and that boys selected tougher projects as compared to girls. There was also evidence of gender stereotyping especially among science teachers, since all held the opinion that boys are better in science fairs compared to girls with some actually insinuating that girls are born weaker in sciences. Such perceptions are quite discouraging to the girls' motivation and change of attitude.

It was also observed that more boys than girls reached higher levels of competition during the period of the study, and that boys' projects get better as they move up the competition levels, while those of the girls don't seem to improve a lot, which make their projects stagnate at lower levels of competition. In general, these findings are consistent with the Social Role Theory of sex differences, which emphasizes the causal impact of gender roles-that is, of people's beliefs about the behaviour that is appropriate for each sex. It argues that some careers in the society are associated with some gender, for example, science has been traditionally seen as a career for men and this might be the reason why more boys are more aggressive to win in science fairs. In summary therefore, the study found gender differences in participation in science fairs in terms of the number of boys and girls involved**,** in selection of projects and in the levels of competition reached. As such, awareness creation on the value of science fairs is urgently needed to curb the situation.

4.4: Selection Processes for Representation in Science Fairs

4.4.1: Introduction

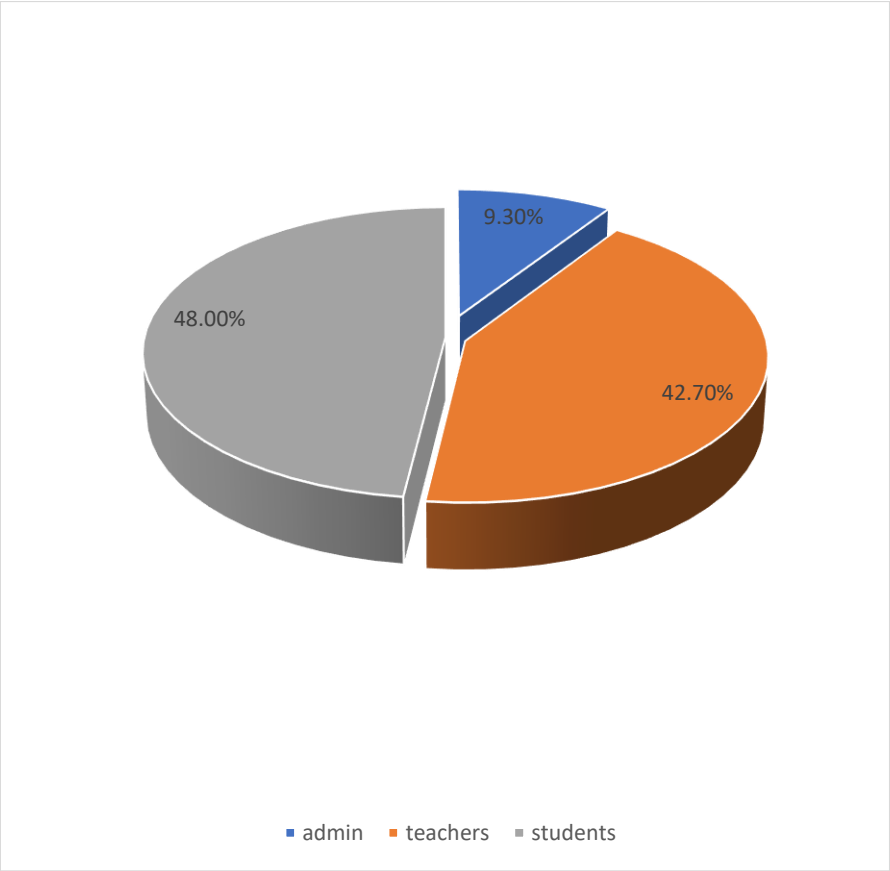
The second objective of the study sought to establish the selection processes in schools for representation by boys and girls in science fair competitions in secondary schools in Thika-west sub-county. This was established through questions in the questionnaire and interview guides. The section has four parts namely; who decides on the students to take part in science fair, what criteria is used to decide on who takes part in the fairs, who decides on the project to be undertaken, and summary of the section.

4.4.2: Who decides on the boys and girls to take part in the Science Fair

The study sought to establish the process of section of both girls and boys in participating in the science fair. This was established by asking the respondents the question: 'Who decides on the

students to take part in science fair? Respondents had the choices; the students themselves, science teachers or the administrative body of the school. Various respondents gave various answers based on their observation and understanding on what has been communicated most probably through school rules and policies. The following figure 4.4.1 summarised responses on who decides on the students to take part in science fair:

Figure 4.4.1: Who decides on the boys and girls to take part in the science fair



On average, most respondents from all schools, both boys and girls felt that students themselves have the highest determination on whether to participate in science fairs or not. Those who felt so were 165 (48.0%) students out of the 344 who responded to the questionnaire. A good number of respondents also felt that it is the science teachers who decide on the participants of science fair,

that is 147 (42.7%) respondents. The least number of all the respondents is the one that felt that selection is determined by the administrative body in school. In other words, 32 (9.3%) students felt that administration has all powers to decide on which students will participate in science fair and which ones will not. The study had initially assumed that the administrative body has the biggest say on who to participate in science fair, posing favouritism on either boys or girls, it however turned out that the voice of both boys and girls matter on equal measures. This implies that schools are not so much to blame for gender differences in the number of boys and girls who participate in science fair competitions.

On the part of the science teachers who were interviewed, one said;

"*We try as much as possible to give the students freedom to choose whether to participate in science fair or not. After all, they are the ones who will do the presentations and therefore is it good to allow them that kind of freedom"* (interviewee, Mr Isaac*).

This kind of argument confirms that even on the part of science teachers, the feeling is that students should and are given the chance to decide whether or not to participate in science fairs. The sentiments of this teacher reflected the answers of three other science teachers.

Mr Joseph* on the other hand said:

"In my school, we, the science teachers decide on who will take part in the fairs. Left to decide, these students may not volunteer at all to take part. We may also have a case whereby students who are never serious at all in school programmes, volunteering to take part. To curb this, the science teachers take up the duty" (Mr Joseph*, male science teacher).

Argument of this science teacher represents 16.7% of the science teacher interviewed, who argued that science teachers have the responsibility of choosing the students to participate in science fairs.

Mr Jude* yet said:

"*The administration is the decision maker when it comes to who will participate in science fairs. They may not allow students who have questionable discipline, or those who are too weak academically to take part in science fair. I think this is the right way to go since it is the administrative body that funds all science fair projects at the school level, and therefore they should not waste money on students who may not go far*" (Mr Jude*, male science teacher).

This same teacher had mentioned to the researcher that science is a hands-on thing and that is does not entirely depend on a person's knowledge of sciences. It was hence sort of a contradiction when he mentioned that the school does not allow students who are academically weak to participate in science fair. The sentiments of this teacher represented 16.7% of the arguments of the science teachers who felt that it the administrative body that should and decides on who to take part in science fair.

Findings of this study are therefore that majority of the students -both boys and girls- are the ones who decide on whether or not to take part in science fairs in Thika-west sub-county since majority of the respondents claimed so. This contrasts the studies by Dionne, Trudel, Reis, Guillet, Kleine, & Hancianu (2011) which found out that in USA, participation of students in science fairs was mainly determined by the administrative body while Mwangi, George & Thinguri (2013) in Kajiado County found out that science teachers are the main determinants on who to participate in which science.

The study also found out that the work of choosing which student participate in the science fair is layered to some extent. To begin with, students choose who to participate, or volunteer to take part, science teachers do the elimination and then give the names to administration for final choice.

In the the second layering, the teachers choose the students and encourage them to participate and then there is a final administration approval.

4.4.3: Criteria for deciding who to take part in Science Fair

The question **'**What criteria is used to decide on who is to participate in science fair?' helped the study find out the criteria for selecting participants in science fair in schools in Thika-west sub-county. The following table 4.4 summarises the information:

Table 4.4: Criteria for deciding who to take part in Science Fair

Criteria for selection	**Boys involved**		**Girls involved**		**Overall**	
	Number	Percent	Number	Percent	Number	Percent
Student's interest	123	35.8	121	35.2	244	71.0
Science teachers' choice	24	7.0	26	7.6	50	14.5
School policy	26	7.6	24	7.0	50	14.5
Total	173	50.3	171	49.7	344	100

Source: Selected Secondary Schools in Thika-west sub-county (2022)

From the above table, it was found out that the main criteria used to select students to participate in science fair in Thika-west sub-county is the students' interest in science. This was in line with the responses of 70.93% (123 boys and 121 girls) questionnaire respondents. Questionnaire respondents who felt that science teachers' choice is the key determinant of who to participate in these science fairs were 50 (14.54%) with 24 girls and 26 girls. The same number (with 26 boys and 24 girls) felt that school policies on participation in cocurricular activities including science fair are the main determinant. Some of the school policies identified as determinants of participation in cocurricular activities were the students' discipline, such that students with records

of indiscipline were not supposed to participate in any cocurricular activities. Others were students' overall performance such that students whose performance is below a certain cut point in different schools were not supposed to participate. Yet other policies stated that students' performance in science subjects was to determine if he or she will get a chance to participate in science fairs.

Asked about his opinion on the participation of boys and girls in science fair competitions, one of the interviewees, Mr Isaac*, a science teacher and judge said;

"*Actually, at the competitions ground, science fair competitions favour girls a lot. For instance, if a girl and a boy undertake a similar technical project like an engineering project, and in the eyes of the judges the projects are both good, judges tend to favour that of the girl to move to the next level of competition. This is done to promote girls' participation in science fairs, since their participation is quite low."* (Interviewee, Mr Isaac*).

Mr John*, asked the same question responded:

"I prefer working with boys as they are vibrant, more creative, positive and willing to explore new ideas compared to girls. I always encourage my male students to participate in science fair for I know they can go far with it unlike girls (Mr John*).

From another interview, it came out that in events where girls and boys are working on the same project, boys do the demonstrations while girls do the explanation. The reason given for this was that girls are good with language and hence can explain the demonstrations clearly unlike boys, while boys are good with practical deals and hence most suitable to tackle the demonstrations.

Judging by these responses, it is clear that science teachers have a lot to say when it comes to the criteria for selecting who to participate. It also emerges that science fair judges are key

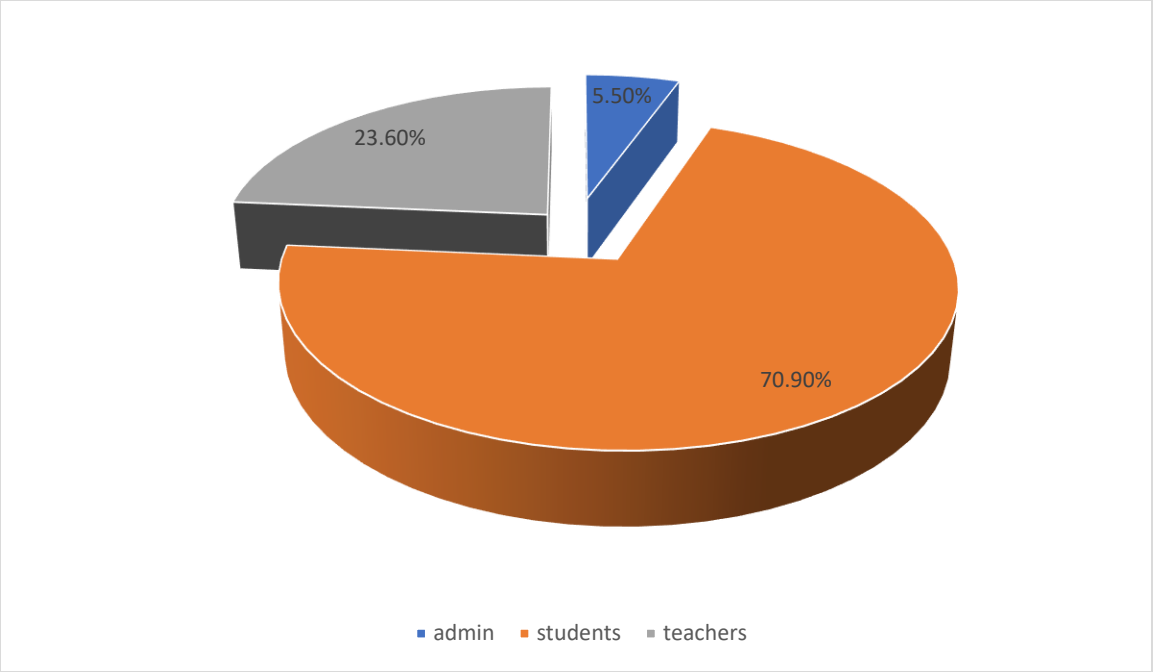
determinants pertaining who to proceed to the next level in the area of study. It is therefore important to instil the discipline of fairness to science teachers and science fair judges to facilitate fairness in the participation of boys and girls in science fairs. This can be done through awareness creation to science teachers and science fair judges.

On average though, majority of respondents, both questionnaire respondents and interviewees, the feeling was that the main criteria used for deciding who to take part in science fairs is by letting students choose what impresses them. This study got different findings from those of Mbowane, De Villiers & Braun (2017) who found out that in South Africa, participation in science fair was mainly determined by the set-out rules in different schools.

4.4.4: Who decides on the project to be undertaken

'Who decides on the project to be undertaken?' was the question that was used to establish the person (s) or body responsible for the choice of project to be carried out by students. The figure below summarises the details:

Figure 4.4.2: Who decides on the project to be undertaken



In figure 4.4.3, 70.93% (244 respondents) felt that students (both boys and girls) in schools in Thika-west sub-county are the ones who decide on which project they will undertake. 23.55% (81 respondents) felt that it is science teachers who decide which project students will undertake while 5.52% (19 respondents) felt that it is the administrative body that decides which projects students will undertake. It is clear that in this sub-county, students have the highest say over the kind of project they wish to undertake. The implication of this is that gender gap in participation in science fairs can be, by a big chunk linked to the students themselves. These findings contradict those of Dionne, Trudel, Reis, Guillet, Kleine, & Hancianu (2011) in Canada and of Kook, DeLisi, Fields &Levy (2020) who established that the administrative body only gave full support to students who did well in sciences to participate in science fairs.

4.4.5: Summary of Selection Processes for Representation in Science Fairs

In summary, findings of the study pointed that majority of students, both boys and girls, in Thika-west sub-county are the ones who decide on whether or not to participate in science fairs. It was also found out that the main criteria for deciding who to participate in the fairs is the students' interest in the fairs while majority of the students, boys and girls alike, are the ones who decide on the projects they will undertake. A reasonable number of respondents -29.7%- however felt that science teachers have the say on who to participate, and the kind of project to be undertaken by students (23.55%). This implies that the science teacher is key in science fairs. The least number of respondents felt that administrative body directly controls who to participate in the science fairs by funding the participants it is interested in only, and that the criteria for selecting participants of science fairs is the school policy. Some school polices were seen to limit students who would otherwise take part in science fairs, especially the policy on students' overall discipline and also students' academic performance, which may not be directly related to performance in science fairs.

Finding of the study, on a different note did not get enough evidence of gender differences in selection of boys and girls to participate in these science fairs competitions. However, it emerged that girls were a little bit favoured at the competition venues, when they attempted technical projects and seemed to tie with boys in the eyes of the judges. It emerged that since girls are not expected to be as good as boys in science fairs, whenever they portray relent in fairs, they tend to win the hearts of the judges and adjudicators who may award them by promoting their projects to the next level of competition. This is itself gender bias where girls are perceived weaker than boys and hence win the pity of the people around them instead of winning on merit (Bruce & Bruce, 2000). It also came out that in shared projects, girls do the explanation bit since they are perceived

to be good in languages, while boys carry out the demonstrations as they are considered better at practical dealings. This was viewed by the research as a gender difference.

4.5: Aspects Affecting Participation of Boys and Girls in Science Fair.

4.5.1: Introduction

The third objective of the study was out to establish the aspects affecting participation of boys and girls in in science fair competitions in secondary schools in Thika-west sub-county. in order to gauge their level of agreement, respondents were asked to rate their agreement with each of eleven statements on a five-point likert scale. Responses ranged from one (strongly disagree), two (disagree), three (neutral), four (somewhat agree), to five (strongly agree). For ease of interpretation, the responses were averaged, with a number closer to five denoting strong agreement and a value closer to one denoting significant disagreement with the claims. The outcome is presented in 3-tier aspects which involve: perceptions and stereotypes, science fair environment-related aspects, and gender-related factors. Summary of the aspects was also given at the end of the section. The aspects are as summarised below:

4.5.2: Perceptions and Stereotyping

The research found that perceptions and stereotypes are key determinants of boys and girls participation levels in science fair competitions. UNICEF (2017) defines gender stereotyping as ‘Ascribing certain attributes, characteristics and roles to people based on their gender.’ UNICEF (2017) goes on to arguing that gender stereotypes can be negative for example the belief that women can’t drive well or that men can not change babies’ diapers; and that they can be benign for example the assumption that women are better caregivers and men are physically and emotionally stronger. When gender stereotypes restrict a person's options in life, such as their

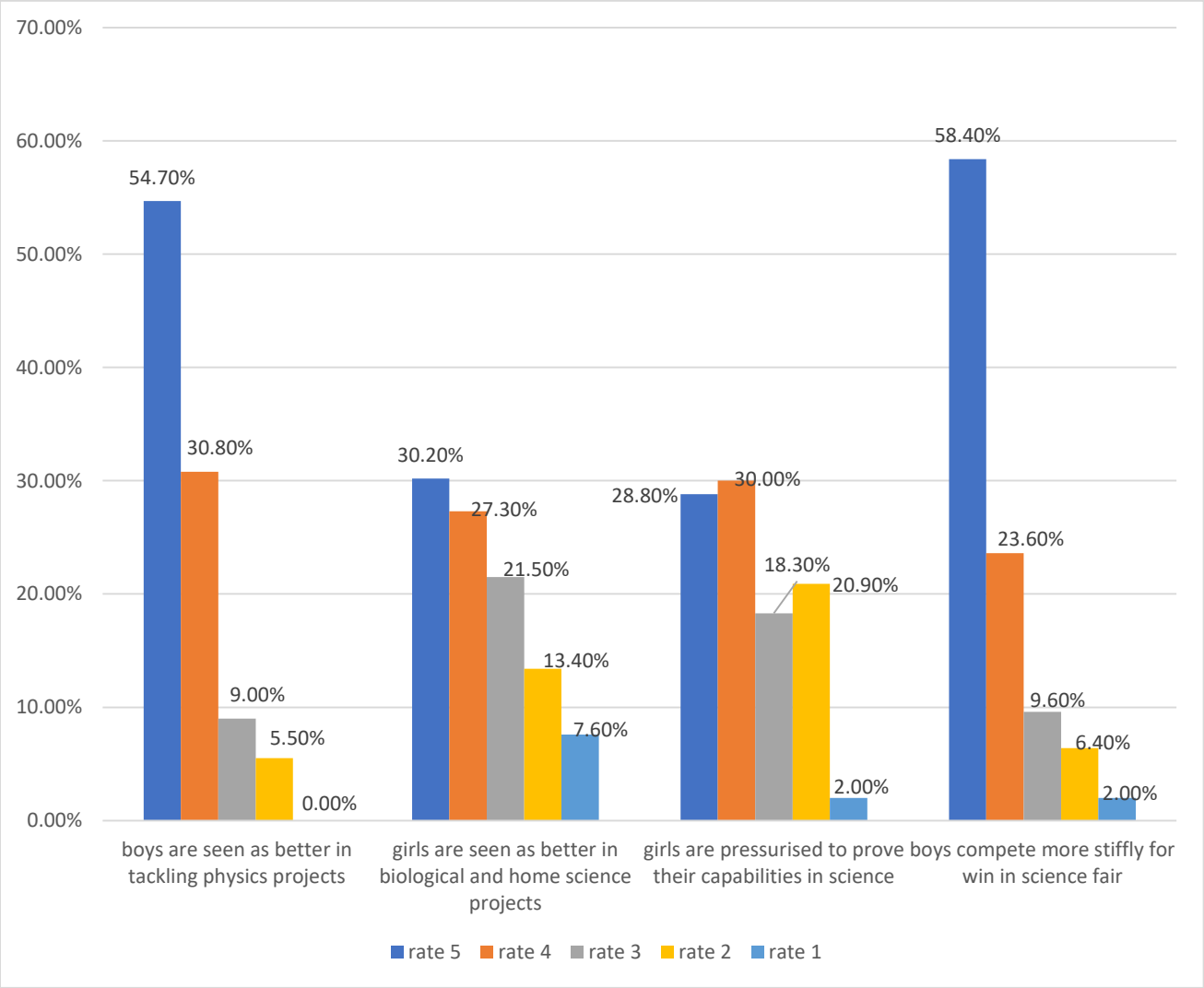
course of study and career, they become damaging. Perception is defined as ‘what is thought to be’ by oxford dictionary. This implies that perceptions are not always true and may not be measured to be either true or false. The two are related in that perceptions may lead to baseless stereotyping of people and what they can or cannot do. By asking respondents to rate items relating to society perspectives and their own perceptions of participating in science fairs, perceptions and stereotypes were evaluated. Perceptions and stereotypes can be assessed in two ways; societal perceptions and perceptions about self as discussed below:

4.5.2.1 Societal Perceptions of Boys’ and Girls’ Participation in Science Fair

In the context of this study, perceptions refer to how society as a whole perceives, understands, and views boys' and girls' participation in scientific fairs. Gasant (2011) observes that one of the more prominent environments where the stereotypically masculine view of science is repeated and where, therefore, it needs to be challenged is the educational system, which both encourages social change to meet the demands of a changing world while also promoting social stability. He maintains that the issue is that while education should support equal human rights, including enabling women and men to have equal access to science and science education, the system is failing to achieve this goal, particularly in the setup of Africa, and that school is seen as a significant venue for upholding the idea that science is a man's field. The way the society perceives men and women, boys’ and girls’ ability in different fields may somehow affect their performance in such fields. This is the same argument of the Social Role Theory by Eagly, & Wood (2012) whose argument is that men and women are thought to possess attributes that equip them for sex-typical roles which are consensually-shared beliefs, in other words known as gender stereotypes. Science has been gendered to be a man’s field (Gupta, 2019) and this may

explain gender discrepancy in science fairs. Societal perception of what men and women, boys and girls can do was reflected in the current study based on the responses given by the different respondent's concerning their perceptions of boys' and girls' participation in science fair as shown in figure 4.5.1.

Figure 4.5.1: Societal Perceptions of Boys' and Girls' Participation in Science Fair



Source: Selected Secondary Schools in Thika-west sub-county (2022)

In figure 4.5.1, 54.7% of the respondents, which was the majority, strongly agreed with the statement that 'boys are considered to be better in tackling physics projects' while 30.8% somehow agreed with the statement, as 9.0% were neutral and 5.5% disagreed with it. There is no respondent who strongly disagreed with the statement. The statement that girls are considered to be better in biological and home science projects was strongly agreed by 30.2% of the respondents; 27.3% somehow agreed with it; 21.5% were neutral to it; 13.4% disagreed with the statement while 7.6% of them strongly disagreed with the statement. The highest number (30.0%) somehow agreed with the statement that girls are pressurised to prove their capabilities in science followed by 28.8% who strongly agreed with the statement while 18.3% were neutral to it, 20.9% disagreed and 2.0% strongly disagreed with the statement. Then the last statement that tested people's perception was 'boys compete more stiffly for win in science fair' to which the majority (58.4%) strongly agreed with, 23.6% somehow agreed with, 9.6% were neutral, 6.4% disagreed with, while 2.0% strongly disagreed with. In addition, the study's participants claimed that boys and girls are really discouraged from or encouraged to compete in scientific fair events depending on how others perceive them. The above responses imply that majority of people perceive boys to be better participants of science fair competitions as compared to girls. This can be clearly explained by reference to all the four statements, which are gender biased with regard to boys' and girls' participation in science fairs, yet three of the four got the highest number of respondents (54.7%, 30.2%, 58.4%) strongly agreeing with them, while the fourth statement got 30.0% 'somehow agree' as the highest response. It can therefore be concluded that among the reasons for gender gap in participation in science fairs in Thika-west sub-county is people's perception and stereotyping of what men and women can and/or cannot do.

Asked how people's perception of things in the society affect the participation of girls and boys in science fair and generally in science, Mr Jude*, said the following:

"Girls are understood as weaker in sciences compared to boys. They are therefore not expected to do as well as boys in science fairs. Science fair is a boys' thing, and that is how boys take it, with vigour and enthusiasm. Boys are expected to produce quality projects. Girls are lucky, the same is not expected of them" (Mr Jude*, interviewee).

The above utterances portray people, inclusive of science teachers, as biased in the way they perceive boys' and girls' participation in science fair. This biased view which portrays girls as less gifted and incapable in science fairs can adversely affect girls' participation in these fairs as girls may lack committed science teachers who are genuinely interested in helping them reach their fullest potential in preparation of their projects.

Mrs James*, a science fair judge and science teacher argued that:

"It is so sad and unfair when some judges consider the projects undertaken by girls as less serious than those of boys, even before thoroughly assessing them. It is even sadder when some judges insinuate that girls are weaker in science fairs and even before seeing their projects. This implies that for the girls with good projects, they really have to prove to the judges beyond doubt that their projects are worthwhile; something that does not happen to the boys' projects" (Mrs James, female science fair judge and science teacher).

It is evident from the aforementioned claim that with a bad perception concerning girls' ability in science fair, girls are discouraged from fully taking part in science fair competitions. While this teacher confirmed that it is wrong to adopt a formed opinion concerning boys' and girls' science fair projects, she did not seem to acknowledge that it is still her responsibility to ensure that this

does not happen, especially through mobilising the other judges to be fair to girls as well as boys during adjudication of science fairs.

Mr Joseph* said;

"There is a boy in my school who brought forth a home science project during auditioning of the projects that would represent the school in competitions. Once we learned that it was a home science project, we could not follow what he was saying as everyone, including me was laughing and not listening to him. We could not take him seriously. How, when we expected a more substantial thing from him? Later I told him to leave such projects for girls, as girls can tackle them more expertly" (Mr Joseph*, male science teacher).

The above confirms how stereotyping can prevent boys and girls from carrying out projects of their interest in Thika-west sub-county. They have to conform to what society views as fit for them to carry out, whether they are interested or not. It also indicates that the projects themselves are gendered such that there are those that are viewed as more important compared to the rest. It similarly appears that the less serious projects are left for girls to tackle while boys go with the tougher and more prestigious ones. This is the same argument put across by the Social Role Theory which argues that the society defines roles for men and women, boys and girls through various ways such as socializing them for those gender specific roles. This can limit boys and girls and hence interfere with their levels of participation in science fair competitions.

All the interviewed science teachers individually argued that since there are less women and girls participating in science activities in Kenya, they should be promoted through genuine support to increase their participation. However, majority of them, such as Mrs James * failed to mention that science fair judges and science instructors ought to contribute to the answer. Thus, in order to

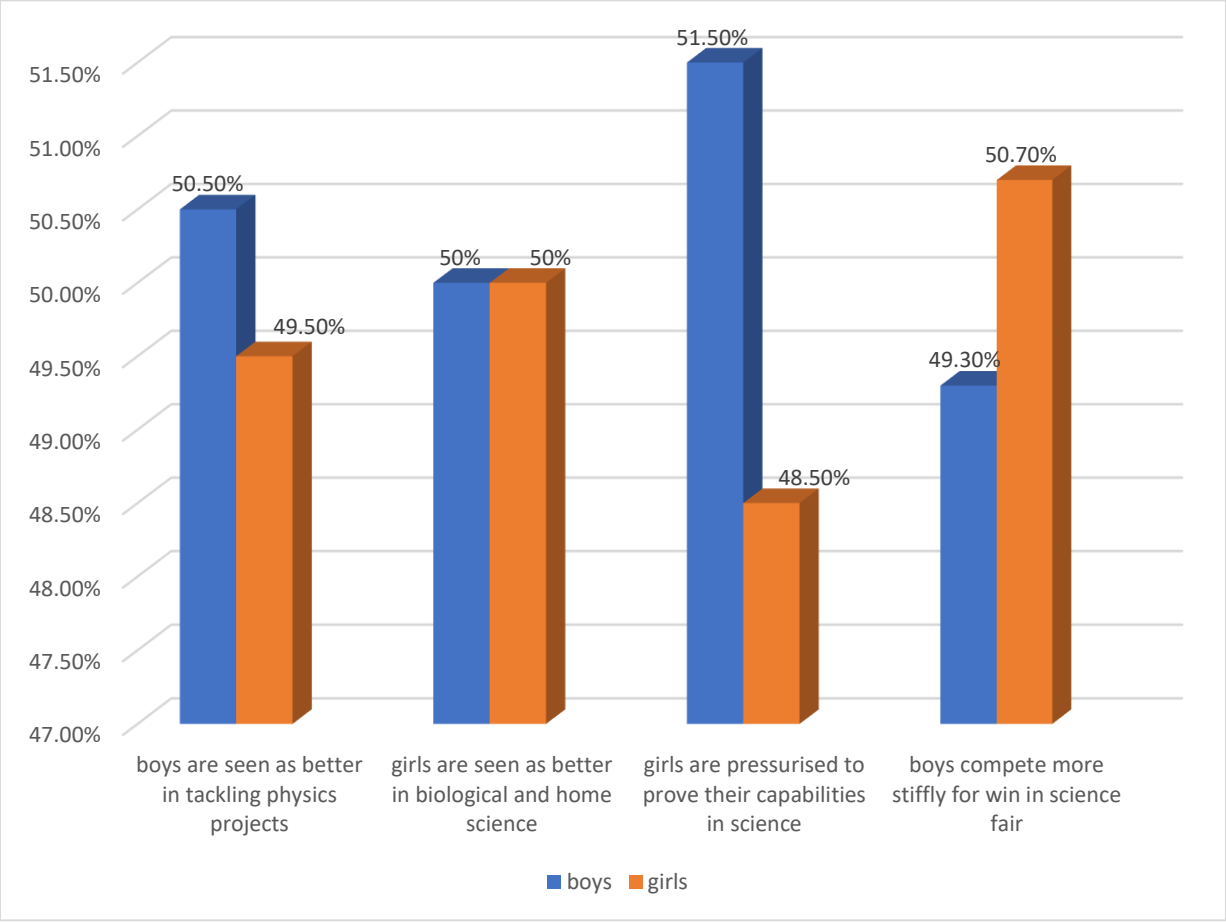
modify people's attitudes regarding women, it is important to promote boys' and girls' participation in science fairs and encourage both to select any project of their choice. Therefore, the research supports the idea that how one feels about the things they engage in can either motivate or demotivate them. In conclusion, in line with Social Role Theory which guides this study, societal actions, attitudes and perceptions towards boys' and girls' involvement in science negatively affects girls' participation in science fair and leading to their low numbers in Thika-west sub-county.

4.5.2.2: Self-perceptions and Participation of Boys and Girls in Science Fair

Apart from societal stereotyping, the study also set to establish individual perception by boys and girls and how this affects their participation in science fair competitions. This was done by doing a gender analysis of how boys and girls responded to the statements that measured perceptions and stereotyping in the society. The study only considered one level of answer; the one that strongly agreed with what is stated, as this answer positively indicates that there was no doubt over their view. This is as portrayed in figure 4.5.2. The figure indicates that out of the 188 respondents who strongly agreed with the statement that 'boys are thought to be better in tackling physics projects, 49.5% are girls while 50.5% were boys. Of the ones who strongly agreed that girls are seen as better in biological and home science projects, 50% to 50% were boys and girls; while those who strongly agreed that girls are pressurised to prove their capabilities in sciences were 48.5% boys and 51.5% girls; and those who strongly agreed that boys compete more stiffly for win in science fair were 50.7% girls and 49.3% boys. In all these statements, the percentage differences between boys' and girls' responses range between 48.5% and 51.5%, a very low difference. For instance, both boys and girls strongly believe that boys are better in tackling physics projects compared to girls, by 49.5% and 50.5% respectively. Therefore, this is a clear indication that boys' and girls'

self-perception surely affect their participation in science fair, such that if boys or girls feel themselves better in some area and not the other, they may not do well in the area they consider themselves incapable. If girls, for example, feel that boys are better in tackling physics projects compared to girls, they may not give their best when tacking physics projects. Figure 4.5.2 summarises boys' and girls' perception of themselves. It only concentrated on the respondents who strongly agreed with the statements given. This this because such responses portray certainty on the part of the respondents to indicate that they are very sure of what they feel.

Figure 4.5.2: Self-perceptions and Participation of Boys and Girls in Science Fair



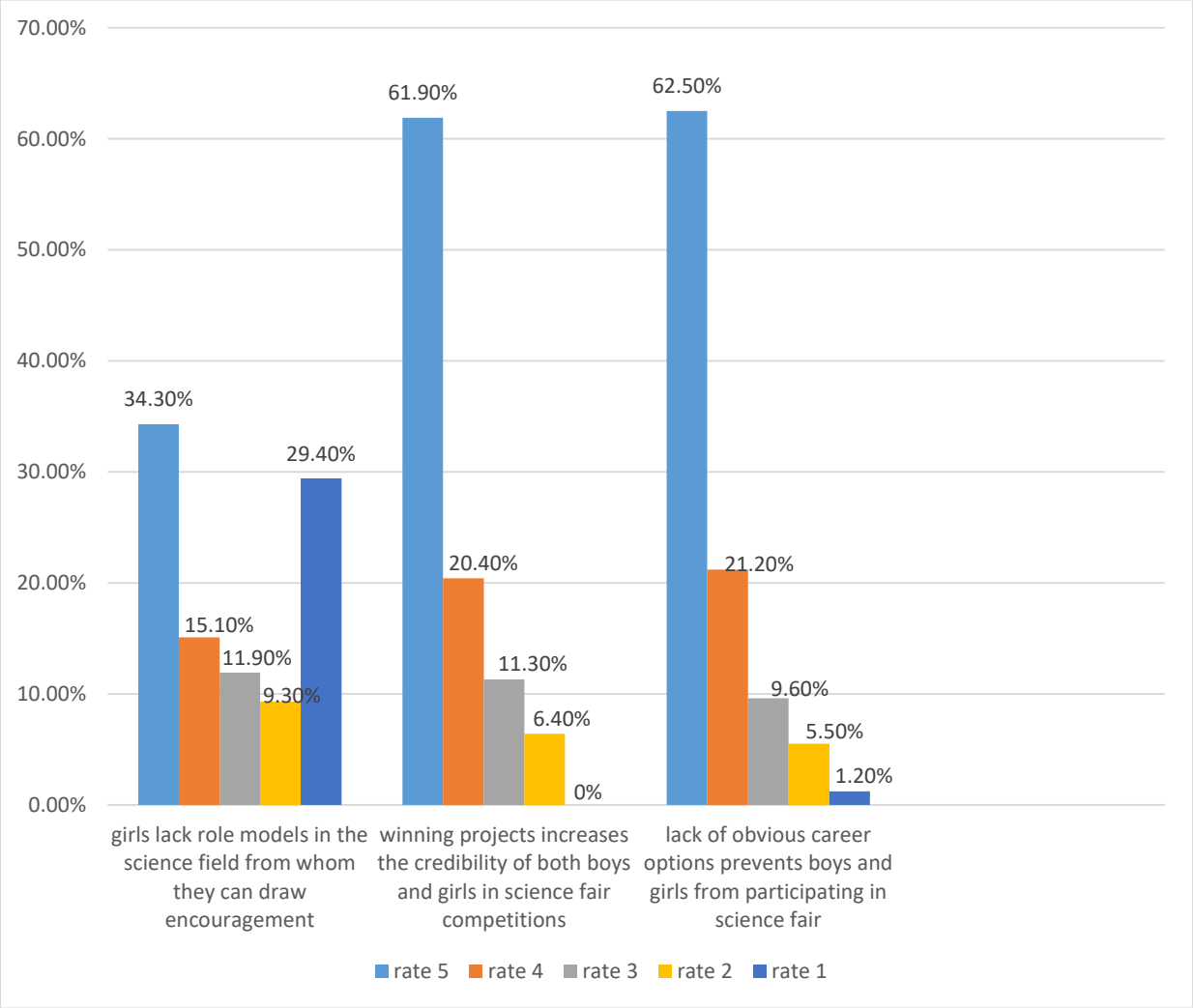
Source: Selected Secondary Schools in Thika-west sub-county (2022)

Going by the details of figure 4.5.2, it is clear that self-perceptions affect boys' and girls' participation in science fair as discussed above. Social role theory which guides the study argues that gender stereotyping almost convinces men and women of their capabilities as people enact specific social roles daily in different capacities and since these gender roles seem to reflect innate attributes of the sexes, they appear natural and inevitable. With these stereotyping, people construct gender roles that are responsive to cultural and environmental conditions yet appear, for individuals within a society, to be stable, inherent properties of men and women (Eagly, &Wood, 2012). Boys and girls in Thika-west sub-county should therefore be guided to improve the perception towards themselves and hence get much believe in their ability. This will help to boost their perceptions in what they can achieve in sciences and in effect improve their participation in science fairs.

4.5.3: Science Fair Environment-related Aspects Affecting Boys' and Girls' Participation in Science Fair

The study found that some of the aspects that determine boys' and girls' participation levels in science fair competitions have to do with the science-fair environment. The science-fair environment here was used to mean the value of the science teachers who coach in the science projects, impact of winning or losing in science fair competitions, and the place of career paths in participation in science fairs. These aspects were evaluated by asking respondents to rate statements pertaining to the science-fair environment. The ratings are as summarised in figure 4.5.3

Figure 4.5.3: Science Fair environment-related Aspects Affecting Boys' and Girls' Participation in Science Fair



Source: Selected Secondary Schools in Thika-west sub-county (2022)

As shown in figure 4.5.3, most respondents (34.3%) strongly agreed that girls lack role models in the science field and therefore they have no one to look up to for encouragement. Role models were viewed in terms of science teachers, female science fair judges and generally female scientists. Finding of this study are therefore in agreement with that of Mupezeni & Kriek (2018) in South Africa who found out that among others, gender differences in participation in

science fair was as a result of lack of role models especially for girls. It is however interesting that a large number, 101 respondents out of 344 strongly disagreed that girls lack role models from whom they can draw encouragement. This might imply that the role models available for girls are enough to encourage them participate in science fairs and that girls' dismal participation in science fair is not just about few role models, but tied to many other things such as poor guidance by science teachers in preparation for these fairs among others.

61.9% of the respondents similarly strongly agreed that winning projects increases the credibility for both girls and boys in science fair competitions. The implication for this is that boys and girls, whose projects win in science fairs, feel more motivated to keep working on these projects an making them better for higher levels of competition. Those whose projects fail to win feel demotivated to keep working and this can lead to subsequent failure in other levels of competition. Data in Thika-west sub-county indicates that boys' projects have been winning more times since 2012, compared to those of girls (Thika-west science fair committee, 2021). This may provide an explanation why girls in this sub-county have lagged behind the boys in science fair competitions, since if boys' projects have been winning more times, it has been an encouragement to the boys unlike to the girls.

'Lack of obvious career options prevents boys and girls from participating in science fair' was strongly agreed by 62.5% respondents. 21.2% of them somehow agreed with the statement. This implies that students' performance in science fair is greatly affected by their career choices such that students with careers in science will tend to participate in science fair more often unlike those without such careers or those who have not serious thought of their careers.

A gender analysis of science fair environment-related aspects was also done. This was to establish whether science fair environment -related aspects affect boys and girls with similar intensity. The analysis was done for responses which strongly agreed with the given statements since such statements were seen to positively give indisputable feelings concerning these Statements. Findings were as indicated in table 4.5.1

Variables	Girls	Boys	Total
1. Girls lack role models in the science field from whom they can draw encouragement	57.6%	42.4%	100%
2. Winning projects increases the credibility of both boys and girls in science fair competitions	49.8%	50.2%	100%
3. Lack of obvious career options prevents boys and girls from participating in science fair	49.8%	50.2%	100%

Table 4.5.1: Environment-related Aspects Affecting Participation in Science Fair

Source: Selected Secondary Schools in Thika-west sub-county (2022)

From table 4.5.1, environment-related aspects affect boys' and girls' participation in science fair with almost equal proportions. Save for the statement 'Girls lack role models in the science field from whom they can draw encouragement' which indicated that girls strongly agreed with this statement more than boys, the other statements were equally strongly agreed by both boys and girls. That is, 50.2% of girls against 49.8% of boys strongly agreed that winning projects increases the credibility of both boys and girls in science fair while the same percentages strongly agreed that 'Lack of obvious career options prevents boys and girls from participating in science fair.'

This implies that environment-related aspects that affect participation of boys and girls in science fairs affect them almost equally and they should therefore be taken care of for boys and girls to fully participate in science fair competitions comfortably.

One of the science teachers and a science fair judge, who were interviewed, when asked whether girls lack role models in science fair from whom they can draw encouragement, said;

"In deed girls lack role models in science fair. For one, female science teachers are few in this sub-county; there are even fewer who participate in science fairs as majority cite lack of time and other commitments. Sometimes I find myself as the only female teacher during adjudication. This might mean for the students that science fair is not a thing for women and hence discourage some girls from participating" (Mrs James, science fair judge).

This response confirmed that girls lack role models in science from whom they can draw encouragement. The response was echoed by all the interviewees that the study interviewed.

Mr Jude*, when asked whether winning projects increases the credibility for boys and girls in science fairs, he said;

"Definitely! The trick is to ensure that your students win, even if in just one project. This psyches them and gives them the impression that winning is for every student and every school. It then motivates them to participate more and with renewed vigour" (Mr Jude* male science teacher).

This response reflected the responses of all the interviewees. The general feeling was that both boys and girls need to win in projects as it motivates them to better their projects in anticipation for a win.

Yet another one, when asked whether lack of obvious career paths in science prevented boys and girls from participating in science fair, said the following;

"Students who often talk about future careers in science tend to participate more in science fairs. There are others who talk about being artistes in future; those ones will mainly be found in drama competitions or debates. We however have others you will find everywhere and I believe those are the ones still finding their careers and have not settled on anything yet" (Mr Isaac*).

From the response of this science teacher and several others who held similar opinions, the study concluded that career paths by a good percentage (over 62% agreed with the statement) determines boys' and girls' involvement in science fair competitions. Students who have careers in science will tend to participate in science fairs more often than those with different career interests.

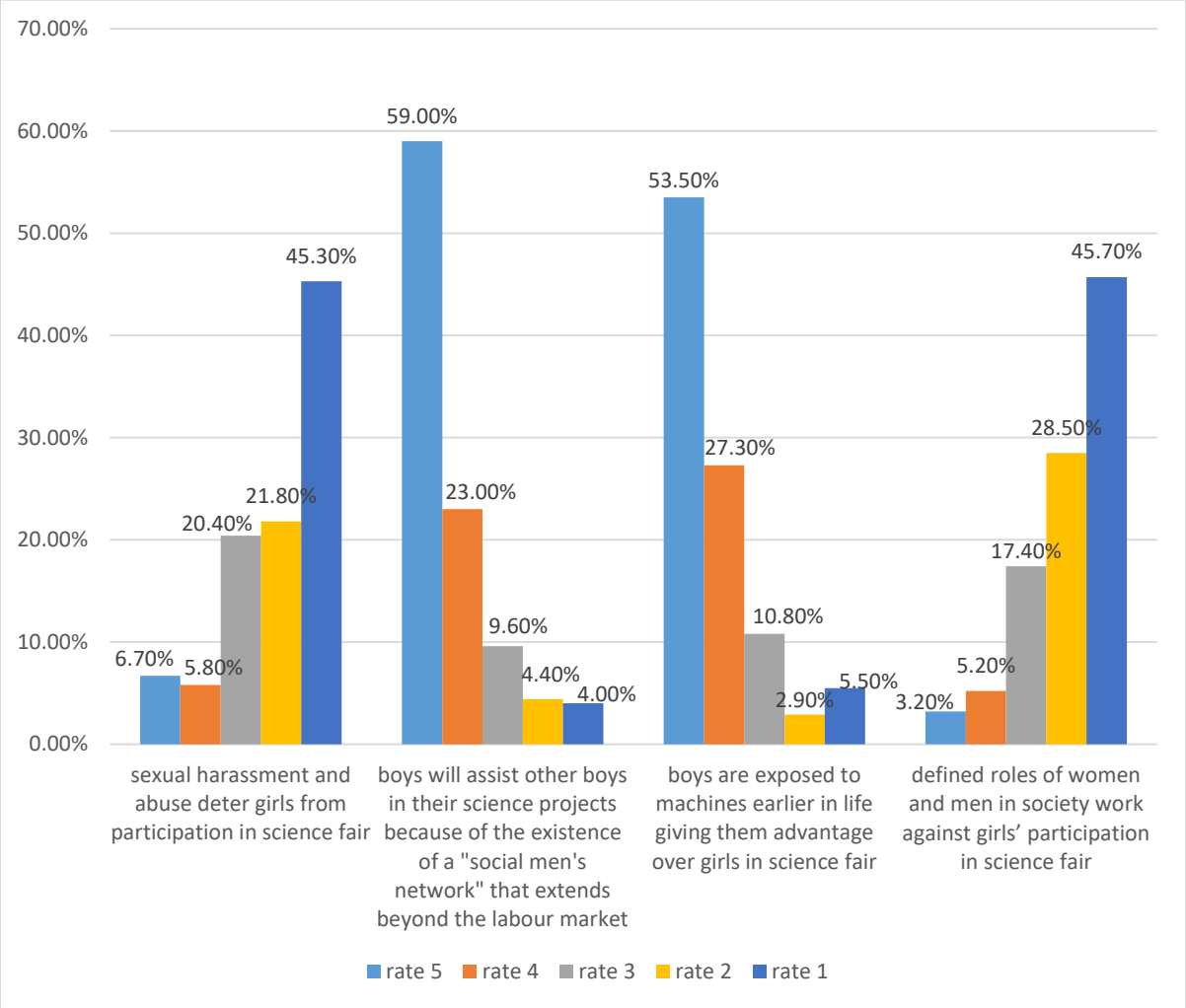
In summary, the study found out that science fair environment-related aspects affect participation of students in science fair such as the influence of the science teacher and nature of career guidance to students. The school environment and science teachers therefore have a duty to ensure that boys and girls get the right guidance in career choosing especially careers in sciences to promote participation of boys and girls in science fairs.

4.5.4: Gender-related Aspects Affecting Participation of Boys and Girls in Science Fair

4.5.4.1: Introduction

Some of the aspects that affect participation of boys and girls in science fair were found to be gender-related. These will be discussed under the following sub-sections: sexual harassment and abuse, team work, exposure to machines, and gender roles. These aspects were established by analysing the responses from the statements which were related to gender as summarised in the following figure 4.5.4:

Figure 4.5.4: Gender-related Aspects Affecting Participation of Boys and Girls in Science Fair



Source: Selected Secondary Schools in Thika-west sub-county (2022)

In figure 4.5.4, majority of respondents (45.3%) strongly disagreed with the statement that sexual harassment and abuse deter girls from participating in science fair, majority (59.0%) strongly agreed that boys will assist other boys in science projects because of the existence of social men's network that extends beyond the labour market, majority (53.5%) again strongly agreed that boys are exposed to machines earlier in life which give them an advantage over girls in science fair,

while another majority (45.7%) strongly disagreed with the statement that defined roles of women and men in the society work against girls' participation in science fair. All these responses indicate gender biasness and can be well interpreted by looking at individual variables as they are stated in the figure. These variables include; sexual harassment and abuse deter girls from participation in science fairs, boys will assist other boys in their science project because of the existence of 'social men's network' that extend beyond the labour market, boys are exposed to machines earlier in life giving them advantage over girls in science fair and the last one is defined roles of women and men in the society (gender roles) work against girls' participation in science fair. They can be discussed under the following sub-headings:

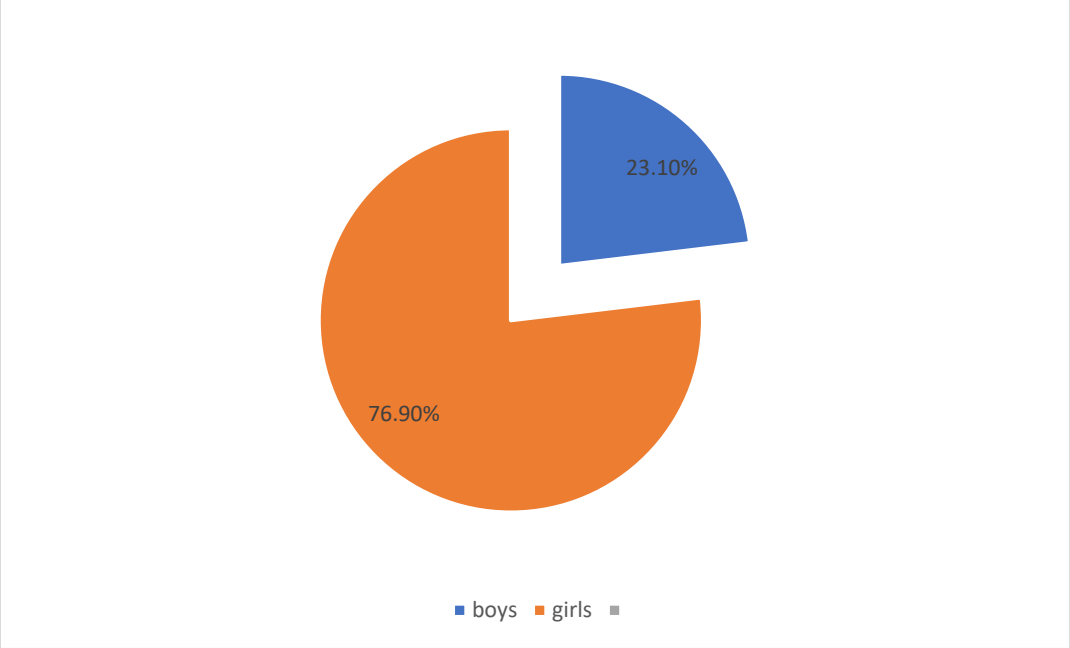
4.5.4.2: Sexual Harassment and Abuse

The statement that "Sexual harassment, and abuse deter girls from participating in science fair" is rated at 6.7%, strongly agree and 45.3%, strongly disagree, as an aspect that affects participation of boys and girls in science fair competitions. This implies that by some degree, girls are sexually harassed and abused by their male trainers, male science teachers or male science fair judges in science fairs. This may be in form of demanding sexual favors from the girls in return for opportunity to participate in science fair competitions or opportunity to thoroughly couch them; or inappropriate touching in the course of training or performance. Any kind of sexual behavior that makes the victim feel uncomfortable including using language (written or spoken) or visual material of a sexual nature plus physical behavior of a sexual nature are considered sexual harassment (Kenyan constitution, 2010). Sexual harassment is a global issue that is experienced across all the disciplines including in science. Majority of the respondents however strongly disagreed that girls are sexually harassed or abused in science fairs. This might imply that apart

from sexual harassment and abuse, other factors play a bigger role in deterring girls from participating in science fair competitions.

Of the students who strongly felt that Sexual harassment, and abuse deter girls from participating in science fair, a gender analysis of the 26 positive responses was also done. The figure below summarises the findings;

Figure 4.5.5: Sexual Harassment and Abuse by gender



Source: Selected Secondary Schools in Thika-west sub-county (2022)

From the above table, 76.9% of students who strongly agreed that sexual harassment and abuse deter girls from participating in science fairs were girls while 23.1% were boys. This indicates that a bigger number of girls than boys strongly felt that sexual harassment and abuse deter girls from

taking part in science fairs. In this case, girls are the victims and therefore it is easy to agree with them that in deed harassment and abuse takes place in science fair environment.

On the part of the interviewees, the following interviewee, a science teacher had the following to say when asked whether sexual harassment and abuse deter girls from participating in science fair competitions:

"*Sadly, some male science teachers we know demand for sexual favours from the girls, especially over the weekend, so that they can help the girls in their projects. Some also like spending too much time with the girls in the pretext of helping them with their projects. It is tricky to tackle such cases because the involved girls tend to cover up for the suspected teachers leaving us only speculating. It is also not easy to know when the teacher and student are involved in constructive work or when they are planning other things. The problem is that in our school, there are only two physics and biology teachers, male ones, and apart from me, they are the only teachers available for science fair"* (Mr Joseph*.)

From the above utterances, it is clear that sexual harassment and abuse happen to students, especially girls as they participate in science fair and this may actually deter them from participating. In spite of severe punishment for sexual exploitation, some of offenders still carry it out. According to the Sexual Offences Act of 2006, any person, who, being in a position of authority, or a person holding a public office, who persistently makes any sexual advances or requests which he or she knows, or has reasonable grounds to know, are unwelcome, is guilty of the offence of sexual harassment and is liable to imprisonment of at least three years or to a fine of at least KES 100,000 or to both. With sexual harassment incidences in science, questions arise as to whether the Sexual Offences Act of 2006 is effective enough in deterring the vice. This also

affirms that sexual harassment in schools should be curbed to promote participation of girls in science fair competitions.

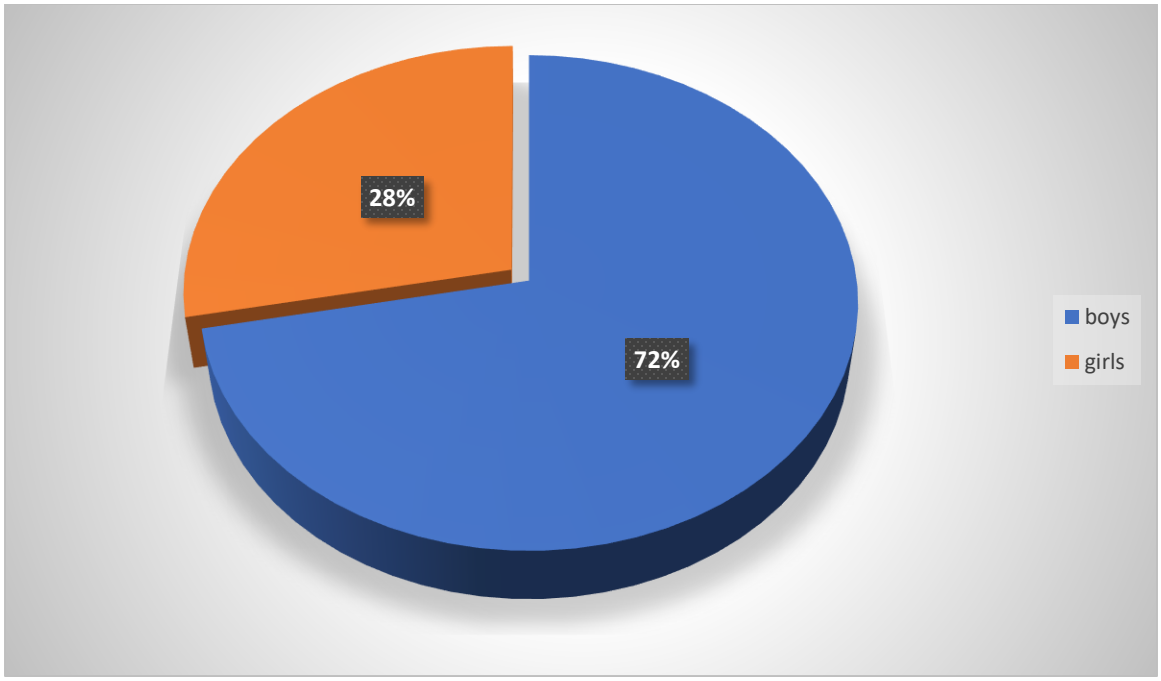
4.5.4.3: Gender and Team Work

In figure 4.5.4, 59% of the respondents strongly agreed that' boys will assist other boys in their science projects because of the existence of a "social men's network" that extends beyond the labour market' while 23% somehow agreed with it. Men are believed to pull and network with other men to keep improving each other, such that in the end, men as a group gain a higher status than women as a group, both in the social and the labour field (Connell, 2012). These "social men's networks are informal "old boys" networks where men are believed to keep healthy friendships for the purpose of ensuring that all men are comfortable especially in the labour market (Vries, Webb & Eveline, 2006). There was strong feeling that majority of boys, especially in boys only schools, are likely to assist each other in their science fair projects such that in the end, each has a well organised and creative projects, instead of competing against each other, they are likely to work together. On the other hand, majority of girls, especially in girls' only schools, were seen to prefer working on their projects alone as this was argued to boost speed and enhance concentration. In mixed schools, respondents were divided on whether boys prefer to work with fellow boys or with girls and whether girls prefer to work with fellow girls or with boys in their projects. On the whole, it however emerged that boys prefer working with fellow boys in serious undertakings such as science fairs.

9.6% of the respondents however were neutral to this statement, while 8.4% ranged from 'disagree' to 'strongly disagree' with the statement. This was a smaller percentage compared to those who agreed and strongly agreed with the statement.

An analysis of gender and team work was established as in the figure 4.5.6 that follows:

Figure 4.5.6: A Gender Analysis of Team Work



Of the 203 respondents who strongly agreed with existence of gender differences in teamwork in which men help fellow men to become better, 146 were males (72%) while the rest were females (28%). This implies a big possibility that in Thika-west sub-county, informal men's social networks exist and see to it that boys help other boys in science fair projects leading to better projects for boys, which are likely to qualify for higher levels of participation.

When questioned over the existence of informal men's social networks and whether boys use them to help other boys in their science fair projects, one of the interviewees had this to say;

"No, never! My male students only help the girls. Actually, they compete against each other such that one can go to the extent of spoiling other ones' projects. Boys will spend even more time helping the girls at the expense of their own projects. Luckily, they always afford time to work on their own projects when everybody else has gone home, otherwise I would not count on the boys' projects in science fair. In my school, boys like it when fellow boys are in trouble" (female interviewee and science teacher)

From this response, one can easily tell that the case may be different for mixed schools and for single sexed schools. Where girls are involved, boys may prefer working with girls instead of fellow boys while they will likely work together in boys' only schools. Another science teacher from a girls-only school said the following:

"*Girls are hard to tell. Sometimes they do their projects together but, in most cases, they end up disagreeing and blaming each other. Those who tackle their projects alone go far. I personally advise them to do their work alone so that they can concentrate well and avoid blame game in case things go south"* (Mrs Dominic*).

This response shows that women are not so much in social networks like men. Girls will most likely work alone in science fair which can be their undoing.

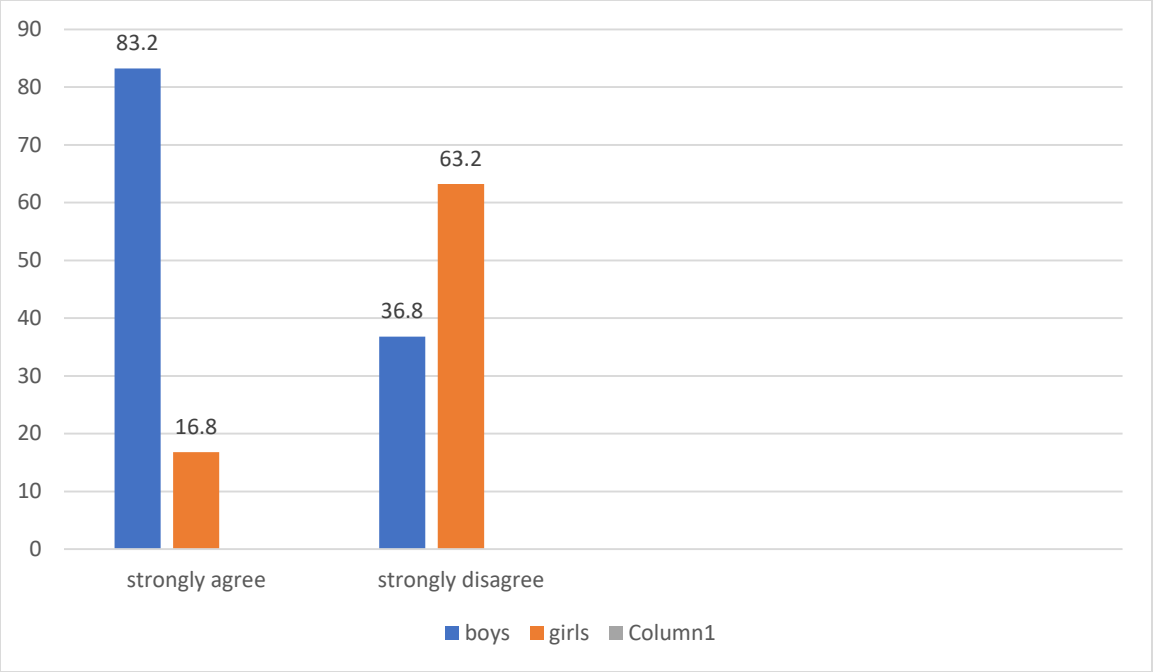
This study therefore concludes that team work exists in science fair competitions to the advantage of boys, as they help each other in their science fair projects and hence end up with well-done projects, something which girls do not do. It is therefore important for science teachers to help

girls work together instead of encouraging them to work individually for combined efforts are likely to take them farther.

4.5.4.4: Exposure to Machines earlier in life

In figure 4.5.4, the statement 'Boys are exposed to machines earlier in life giving them advantage over girls in science fair' was responded in the following matter; 53.5% strongly agreed, 27,3% somehow agreed, 10.8% were neutral, 2.9% disagreed while 5.5% strongly disagreed. It is therefore clear that the majority of respondents felt that boys are exposed to machines earlier in life giving them advantage especially in projects that involve tinkering or machines in general. Findings of this study agree with those of Lawton, & Bordens (1995) and Greenfield (1995) which had found out that boys' advantage in science fair was connected to their exposure to machines in early life compared to girls. The question however received different responses between boys and girls as indicated in the following figure. The researcher only concentrated on the highest rating of the responses (5 rating) and lowest rating (1 rating) as they express strong believe, either strongly agree (5) or strongly disagree (1 rating). The figure below summarises the responses:

Figure 4.5.7: Boys are exposed to machines earlier in life



Source: Selected Secondary Schools in Thika-west sub-county (2022)

From the figure, majority of the boys (83.2%) are the ones who strongly agreed with the statement that 'Boys exposure to machines earlier in life gives them advantage over girls in science fairs.' On the other hand, 63.2% of the girls strongly disagreed with the statement. This implies that more boys than girls feel that boys' exposure to machines earlier in life gives them advantage over girls in science fair. Therefore, this is just one among other aspects that affect participation of boys and girls in science fairs. Concerning exposure of boys and girls to machines at an early age, one of the science teachers had this to say:

"Boys have an easy time when it comes to disembarking and assembling machines of any kind during science fairs. Majority of girls on the other side are seen to struggle a lot and at times are not successful even after struggling. Indeed, this has to do with the familiarity that boys have with machines as a result of timely exposure to them. For girls it is not the same thing. Girls are exposed to other things early in life but not so much to machines. This brings the difference" (Mr Joseph).

From these utterances, one can deduce that boys have an advantage in science fair fairly as a result of their timely exposure to machines such as toy cars, aeroplanes or other ordinary machines such as fixing the door or other home machines which may not need to be taken to a specialist. Girls on the other hand may lack such expertise as a result of exposure to other non-mechanical things earlier in life. Therefore, the study found out that by reasonable degree, early exposure to machines affects boys' and girls' participation in science fair, similar findings to that of Greenfield (1995). Girls as well as boys should therefore be exposed to machines early in life to help girls familiarise themselves with machines and hence get ample time with machines during science fairs. This can be done through involvement of both girls and boys in machinery work both as home and in school, and also through mobilization for the same.

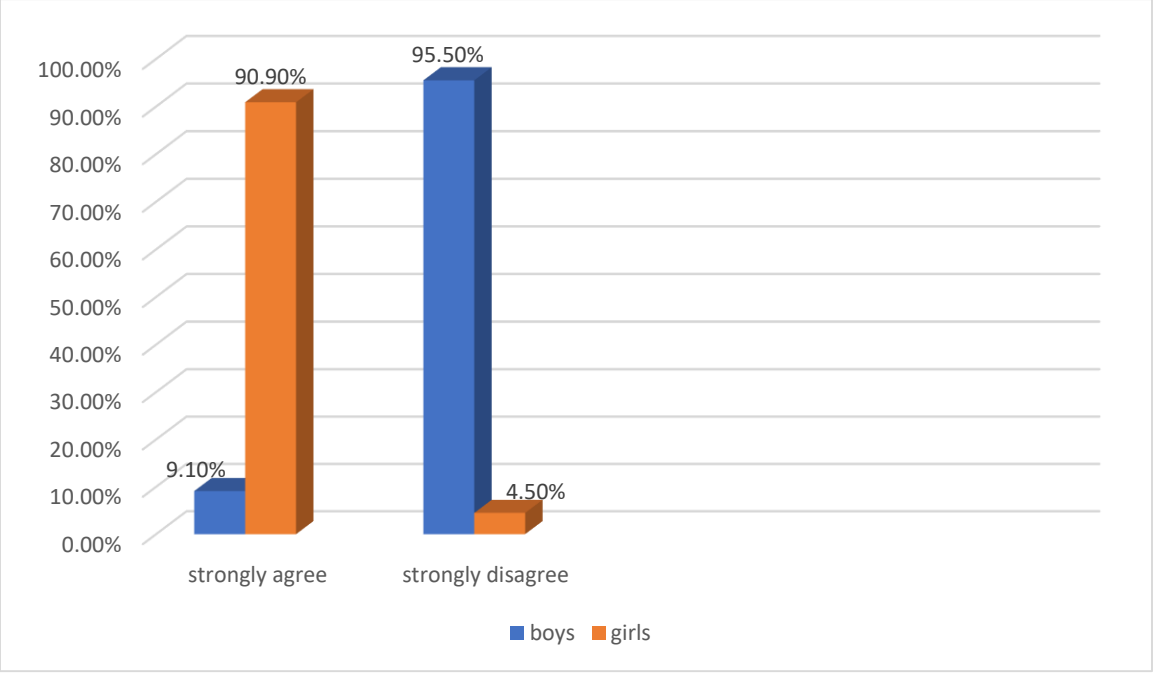
4.5.4.5: Gender Roles and Participation of Boys and Girls in Science Fair

Gender roles are based on the different expectations that individuals, groups, and societies have of individuals based on their sex and based on each society's values and beliefs about gender and are the product of the interactions between individuals and their environments, and they give individuals cues about what sort of behavior is believed to be appropriate for what sex (UNICEF, 2017). Appropriate gender roles are defined according to a society's beliefs about differences between the sexes (Blackstone, (2003). It is therefore possible that gender roles affect participation of boys and girls in science fair. This is because boys and girls come from the society, which defines roles for men and women.

This aspect was assessed by plotting the statement 'Defined roles of women and men in society work against girls' participation in science fair.' As indicated in figure 4.5.4 Majority of the questionnaire respondents strongly disagreed with the statement by 45.7% while the fewest (3.2%) number strongly agreed with it. This therefore means that majority of the students do not believe

that their actions especially in science are affected by gender roles. Gender analysis of the boys and girls who strongly agreed, and those who strongly disagreed with the statement were as shown in the figure 4.5.7 below;

Figure 4.5.8: Gender roles and participation of boys and girls in science fair



Source: Selected Secondary Schools in Thika-west sub-county (2022)

More girls, 90.9%, than boys (9.1%) strongly agreed that defined roles of women and men in society work against girls' participation in science fair while more boys (95.5%) than girls (4.5%) strongly disagreed with the statement.

One the science teachers, an interviewee said this concerning gender roles;

"Boys prefer projects that lead to careers and which can help them earn a living in the long run. When they talk about their projects, one can always feel that they would like to do something related to their projects in the future years. They also like working with projects related to activities that can earn lots of money and make life comfortable unlike those that make the environment clean. On the other hand, most girls choose projects that seem tied to their duties in future. They tend to choose environmental projects such as way of keeping the environment clean, removing stubborn stains or modern methods of cooking, and others inclined to the environment and home science" (interviewee and male science teacher).

These utterances indicate that gender roles by affect participation of boys and girls in science fair, especially in the choice of the project to undertake. It is clear that the kind of projects boys choose are in line with the bread winner roles as one of the major traditional gender role of men in the society is the provider role (Ercan & Uçar, 2021) while the projects of the girls can be linked to home maker gender roles, traditionally reserved for women (Ercan & Uçar, 2021).

Findings of this study are therefore in agreement with those of Campion, & Shrum (2004) in Ghana, Kenya and India, who argued that gender disparities in research systems of developing nations can be specifically linked to conventional familial responsibilities. The findings are also aligned to the social role theory, which argues that since gender roles seem to reflect innate attributes of the sexes, they appear natural and inevitable and therefore in this way people ensure

that the gender roles are responsive to cultural and environmental conditions. It also argues that to equip men and women for their usual family and employment duties, societies undertake extensive socialization to promote personality traits and skills that facilitate role performance. This can well explain why science teachers will most likely equip boys with projects that can easily help them earn a living and support their families, such as projects on technical fields such engineering, trade and transport while equipping girls with ideas that help them be good home makers such as projects on home science and environmental safety.

4.5.5: Summary of Aspects Affecting Participation of Boys and Girls in Science Fair

In summary, the findings in this section indicate that several aspects affect the participation of boys and girls in science competitions most of which inhibit girls' involvement in the said fairs. These aspects were classified under three major umbrellas namely, those that are related with perceptions and stereotypes, environment-related aspects and those related with gender.

Under those associated with perceptions and stereotyping, the study found out that some projects are associated with some genders. For example, tackling physics projects is mainly associated with boys such that the science fair environment believes that good projects in physics can only be undertaken by boys and not girls. This works against girls wishing to undertake projects in the physics field since, and as suggested by the Social Role Theory which guides the study, girls will be expected to work extra harder to prove the world that they can do as well as boys in the physics projects. On the other hand, boys will have to bear with the demeaning attitude associated with projects like those in home science which are viewed as 'girlish staff' by the society. They are also expected to compete stiffly for win in science fair such that if their projects tie with those of the girls, girls are likely to get the win simply because they are female. Gasant (2011) had made a similar observation, noting that there are gender biases present in the perception of science, its

jobs, and vocations, leading both boy and girl students to believe that science is a man's world. As a result of this stereotyping of science fair, participation of boys and girls in science is adversely affected (Agufana, 2015).

The other aspects were put under the umbrella of environment-related aspects. These are the aspects that can be associated with school environment. The study found such to be aspects like girls lacking role models in the science field which implies that they have few to no role models from whom to draw encouragement in their quest to pursue scientific fairs or generally science. Role models were viewed to be inform of female science teacher, female science fair judges or simply female scientists. The other environment-related aspect was identified as 'winning projects increases the credibility of both boys and girls in science fair competitions.' Concerning this aspect, majority of respondents strongly agreed that it really affects the participation of girls and boys in science fairs. The study found out that when the students won science fair projects, they got more confidence to make the projects better or even to undertake other more demanding projects. Findings of the study showed that most of the projects that won belonged to the boys, and hence this can explain why they kept winning. The issue of lack of obvious career options prevents boys and girls from participating in science fairs and just like in the study by steegh (2021), it was found to truly affect participation in science fairs.

Gender-related aspects were also discussed. The study, like that of Lakin, Ewald, Hardy, Cobine, Marino, Landers & Davis (2021), found out that gender-related aspects are a major determinant of participation of boys and girls in science fairs. Gender-related aspects were identified as sexual harassment, which was reported to be taking place in the science fair environment, through different ways, such as asking for sexual favours from the girls, especially by the male science teachers, in exchange for assistance in science projects. Gasant (2011) also observed that science

is gendered such that it is viewed as a man's domain and that women who wish to participate in it are viewed as just wanting to compete with men, something negative. Under gender-related aspects, the study found out that men really like working in groups through which they assist fellow men (Gasant, 2011) to become better. Defined roles of women and men were also seen as an aspect that affects participation of boys and girls. The roles of 'wife' and 'mother' which are typically viewed in terms of the specified activities and role connections connected with their fulfillment (Campion, & Shrum, 2004) were seen to play a role in boys' and girls' participation in science fair especially in the kind of projects that boys and girls choose to undertake. In a nut-shell, gender-related roles were seen by the study to affect the participation of boys and girls in science fair competitions.

While it widely agreed that these aspects are stereotypical and hence societal, school-related or gender-related, it is similarly agreed that girls themselves have little self-determination to face the barriers associated with the aspects. As underlined by Eagly, & Wood (2012) in social role theory, there are people from several societies who have successfully challenged masculine hegemony. This shows that girls can mobilize forces that have the potential to fundamentally alter the attitudes and prejudices that support male domination and inequities. All in all, despite the difficulties that challenge girls in their participation in science fair, a number of them in Thika-west sub-county have been making it the national level against all odds, beating several boys in these fairs and even engaging in the toughest projects (Thika west sub-county science fair committee, 2021).

4.6: Strategies to Enhance Participation of Boys and Girls in Science Fair

The study's fourth goal was to find solutions to the problems that both boys and girls have when competing in scientific fairs. In evaluating the strategies to promote boys' and girls' participation in science fair, questionnaire Respondents were given seven potential tactics and asked to assess

their agreement with each one on a 5-point Likert scale. The responses ranged from one (Strongly Disagree), two (Disagree), three (Neutral), four (Somewhat agree) to five (Strongly Agree). As presented in table 4.6.1, for simplicity of understanding, the responses were averaged, with a value closer to 5 denoting strong agreement with the propositions and a value closer to 1 denoting significant dissent. After general presentation, the outcome was then presented in three categories: Strategies leaning on workshops meant to boost self-image, gender equality awareness and role modelling and mentorship. There were also strategies that came up from the structured interview respondents. Table 4.6.1 is presented below:

Table 4.6.1: Strategies to Enhance Participation of Boys and Girls in Science Fair

	Variables	Rate 5	Rate 4	Rate 3	Rate 2	Rate 1	total
1.	Change the stereotypical view of girls' involvement in science fair through public education	203 59.0%	76 22.1%	32 9.3%	20 5.8%	13 3.8%	344 100%
2.	Add women judges and adjudicators in science fairs to act as role models for girls who want to participate in science fair	215 62.5%	63 18.3%	33 9.6%	23 6.7%	10 2.9%	344 100%
3.	Conduct workshops on self-image for secondary school boys and girls to make them more assertive as they participate in science fair.	213 61.9%	75 21.8%	43 12.5%	11 3.2%	2 0.6%	344 100%
4.	Ensure that there is no gender harassment or prejudice at the science fair environment.	200 58.1%	79 23.0%	51 14.8	9 2.6%	5 1.5%	344 100%
5.	SEMASTEA and Government Departments need to sponsor girls and boys to train on demands of science fairs.	275 79.9%	42 12.2%	20 5.8%	4 1.2%	3 0.9%	344 100%
6.	Engage girls and boys equally in science fair.	273 79.4%	46 13.3%	18 5.2%	4 1.2%	3 0.9%	344 100%
7.	Portray boys &girls in diverse roles in science fair.	276 80.2%	41 11.9%	18 5.2%	5 1.5%	4` 1.2%	344 100%
8.	Change the stereotypical view of girls' involvement in science fair through public education	203 59.0%	76 22.1%	32 9.3%	20 5.8%	13 3.8%	344 100%

Source: Selected Secondary Schools in Thika-west sub-county (2022)

In the table, it can be seen that most respondents strongly agreed with the strategies suggested by the statements, ranging from 58.1% to 80.2% respondents. This implies that the respondents found

the strategies suitable to tackle the challenges facing girls and boys in participation in science fair. The lowest number of respondents, ranging from 0.6% to 3.8%, strongly disagreed with the statements. These strategies are covered in more detail in the subsections that follow, as shown below:

4.6.1: Workshops to boost Self-image

Majority of respondents (61.9%) strongly agreed with the statement that "Workshops on self-image and assertiveness skills need to be conducted to make secondary school boys and girls more assertive as they participate in science fair. 21.8% somehow agreed with the statement, 12.5% were neutral concerning the statement, 3.2% disagreed with it while 0.6% strongly disagreed with it. The study therefore found out that conducting of workshops is a suitable strategy to bridge gender gap in participation in science fairs.

On the same note, Mrs James* a science teacher and science fair judge explained:

"*Most of our girls fail to participate in science fair not because they are incapable of understanding the science fair language but because of other factors. Some have failed to participate citing reasons related to themselves such little or no confidence and lack of interest in science fair. If they worked on their confidence, they would be good to go. Forums such as workshops and seminars aimed at educating the girl child on their self-worth should hence be created to help these girls boost their confidence in tackling scientific fairs* (Mrs James*, female science teacher, science fair judge and interviewee).

This perspective emphasizes the great role of conduction of workshops in involvement of girls and boys in science fair competitions. In light of the aforementioned, the data suggest that lack of self-motivation is a barrier for boys' and girls' participation in scientific fairs. In support of this

assertion, Gupta (2019) points out that women's underrepresentation in the science field is a personal issue since fewer women have the will and interest to become renowned researchers. To tackle the problem of low self-belief, the respondents supported conducting of workshops on self-image and assertiveness strategies aimed at developing women's confidence in science fair competitions and generally in sciences. Participating in scientific fairs entails learning through social interactions that help individuals get over the fear associated with having no self-confidence and assertiveness. Considering this claim, Beura (2016) is supportive of the belief that exposure to scientific activities such a symposia and science workshops for students gives them a chance to consider themselves in the context of their social environment. Additionally, Croxon and Marshal (2004) advise women to look for educational possibilities that are in line with their preferences and aspirations in order to have a greater understanding of their individual worth and to guarantee their continued advancement in a variety of disciplines of interest, such as science. In the researchers view, SEMASTEA (Society of Engineering, Mathematics, Science and Technology in East Africa), SMASSE (Strengthening of Mathematics and Science in Secondary Schools) and other government bodies that are aligned to science and STEM such as National Commission for Science, Technology& Innovation (NACOSTI) and Royal Society for Chemistry (RSC) should work with international bodies such as Iinternational Science Council (ISC) and Inter Academy Partnership (IAP) to sponsor girls and boys to train on the demands of science fair and also to boost the students' self-perception as far as their abilities in sciences is concerned. The science fair committee in Thika-west sub-county should liaise with other science fair committees, including the Kenya national science fair committee to promote, co-ordinate and implement local, nationwide and inter-national science fair programs in Kenya, and organize training, administer together with co-ordinate science fair courses for both science teachers and students. The Social

Role Theory clearly points out that the society ascribes roles to males and females in the society which they should adhere to. Failure to point out at retrogressive or unfair ascription of these roles to the members concerned can lead to individuals in the society getting trapped in backwards ideologies of what they can or cannot do. Sciences have long been viewed as a man's thing hence this can disadvantage women and girls wishing to pursue scientific careers and undertakings. One way to achieve this is through mobilization through seminars and workshops.

4.6.2: Creation of Gender Equality Awareness

The need for gender equality was tested by asking the respondents on their view about the strategies: change the biased stance on girls' involvement in scientific fair through public education, engage girls and boys equally in science fair and portray boys and girls in diverse roles in science fair. The biggest number of respondents; 59.0%, 79.4% and 80.0% respectively strongly agreed with these strategies. This implies that people are aware of existence of gender inequality in science fair competitions.

UNICEF (2017) defines gender equality as: 'the concept that women and men, girls and boys have equal conditions, treatment and opportunities for realizing their full potential, human rights and dignity, and for contributing to (and benefitting from) economic, social, cultural and political development. Gender equality is, therefore, the equal valuing by society of the similarities and the differences of men and women, and the roles they play. It is based on women and men being full partners in the home, community and society. Gender equality implies that the interests, needs and priorities of both women and men and girls and boys are taken into consideration, recognizing the diversity of different groups and that all human beings are free to develop their personal abilities and make choices without the limitations set by stereotypes and prejudices about gender roles.

Gender equality is a matter of human rights and is considered a precondition for, and indicator of, sustainable people-centered development.'

Gender equality is therefore an important aspect in fostering participation of boys and girls in science fair. Awareness creation on gender equality helps to put boys and girls on level ground as they embark on participating in science fair competitions, to help remove gender bias for both of them.

Gender inequality in science fair was confirmed in the following utterances by a science teacher and science fair judge during an interview:

"Girls are on average weaker than boys in science fair. They rarely undertake demanding projects such as projects in energy and transport or projects in engineering; these areas are the boys' domain, and we know boys do much better in them. Whenever girls set to do such projects, we know they can't go far. Let them stick to environmental and home science projects. In those, very few boys can outdo them. Besides, it is easier to couch boys in projects since they are more creative and eager to learn new things (male science teacher and science fair judge).

Such utterance by an important person in fostering participation of boys and girls in science fair, is indeed worrying as to whether boys and girls really get equal chances to participate in these fairs and more so to embark on projects of self-interest.

It is therefore important to change the stereotypical view of girls' and boys' involvement in science fairs and in science in general through public education on importance of adopting gender equality in the design for full benefit of both girls and boys. Beura (2017) observes that the society has produced scientific women throughout the centuries, who could develop the very basics in understanding of scientific technology but unfortunately, they have been continuously hurdled to

be accepted in the field of science. He continues to hope that the socio-scientific transformation, in due course of time will realize the importance of gender equality for healthy and developed society. Gender stereotyping has been proven to work to the detriment of the girls compared to boys, and therefore in order to increase the participation of girls in science fair, and in partaking any projects, especially in Thika-west sub-county, where data has indicated the participation of girls is lower than that of boys, it is important to urgently create awareness on gender equality for both students and teachers through any available forums such as school assemblies, gender equality clubs, workshops and seminars to normalise the situation.

Achievement of gender equality will also ensure that there is no gender harassment or prejudice at the science fair environment. 58.1% of the questionnaire respondents (figure 4.5.4) strongly agreed that gender harassment needs to be addressed in science fair environment. This is an indication that harassment indeed takes place in these environments, deterring boys and girls from fully participating in science fair competition.

Another measure of ensuring that there is gender equality in the science fair field is by engaging boys and girls equally in everything about science fair, ranging from choice of projects to planning of the programme of performance during the competitions. One of the science teacher and science fair judge said this concerning the programme of the science fair;

"*Sometimes I prefer when girls begin their presentations before boys so that they can finish and go. Their work is always shoddy. Boys have the thing. I always find myself absent-minded when girls are doing their presentations, especially those in day schools, for I know they can't have anything useful." However much we try to place them at par, boys will always outshine girls in science fair for they have mastered the skill* (male science teacher and science fair judge).

The utterances of this teacher indicate gender biasness in the planning and performance as well as in scheduling of the programme during science fair competitions. The utterances insinuate that performance of presenters is programmed depending on the perception of the judges concerning the students rather than using a logical criterion such as similarity between the projects, for easier comparison.

To encourage gender equality in science fairs, it is also important to portray boys and girls in diverse roles in science fair. This strategy was strongly agreed my most respondents (79.9%) in table 4.6.1, overall, compared to those who did not. Boys and girls should be portrayed in diversity in all available forums; in school and outside, including when we give every day examples, to make people aware that boy and girls are not limited in any role by being male or female.

In summary, gender equality is an important strategy of promoting gender equitable participation in science fair competitions. It is almost the engine of ensuring that boys' and girls' participation to their maximum levels in science fair as it ensures equal opportunity is given to all participants based on their capabilities but not gender.

4.6.3: Role Modelling and Mentorship

Most of questionnaire respondents (62.5%) strongly agreed on the strategy of adding women judges and adjudicators in science fairs to act as role models for girls who want to participate in science fair. Formal mentoring programmes for women have become a popular strategy to combat some of the difficulties women face in a male-dominated environment, including lack of easy access to informal "old boys" networks, shortage of appropriate mentors, lack of access to sponsorship and patronage, and inability to navigate the political maze (Vries, Webb & Eveline, 2006). Formal mentoring programmes therefore work to re-create the informal partnerships that

have always occurred in institutions, particularly for men, and to make these partnerships available to women and other groups who would not normally be included.

Mrs James*, a science teacher and science fair judge had this to say concerning role modelling and mentorship in science fairs:

*"There are very few female sciences fair judges in Thika-west sub-county and in indeed at national level. This can easily be linked to few female science teachers in schools. There are even fewer teachers in the physics subject, yet most technical projects lean to the physics subject. It is true that girls may be lacking role models to look up to especially when they enter the science fair contests, only to find male judges, and no or very few female ones. Sometimes it is even hard to convince male counterparts that a certain girls' project is worth pushing for the next level, especially where they have formed opinions" (*Mrs James, female science fair judge).

The above narration undoubtedly confirms that that girls need mentors in the science field to be able to participate fully in science fair competitions. These role models can be in form of science teachers, female science fair judges or prominent people in the field of science who can help the girls believe that they are capable of tackling scientific activities like science fairs.

Role modelling can begin from promoting more females to enrol in scientific courses in post-secondary institutions and more so in teacher training institutions to promote enrolment of more science teachers who in turn will mentor the girls to take part in scientific programmes like science fairs. Female students who participate in science fairs can also be used to mentor other female students to participate in science fairs through rewarding and recognition as was suggested by another science teachers who said the following:

"*In our school we boost the participation of girls in scientific programmes such as science fairs and science symposia through giving rewards and simple recognition. Girls who do well in science subjects and mathematics are called to the front during school's general assemblies, where they are rewarded by simple things such as books or writing pens. Sometimes the other students are simply told to clap their hands for these girls, and this tends to work miracles. We have seen girls improve greatly in sciences after we introduced this strategy"* (male science teacher, interviewee).

From the above speech, participation of girls in science fair can be increased by creating mentors and role models from the students' body. Girls can be encouraged to mentor other girls for scientific programmes such as science fairs.

In summary, female role models are needed in Thika-west sub-county to mentor more girls to take part in science fair since evidence indicates that girls are fewer in science fair competitions compared to boys. This can be done through encouraging more girls to study science subjects in teacher training colleges so that the issue of few female science teachers can be sorted. Female teachers in science subjects should also be encouraged to take part in training boys and girls in science fair projects so that they can mentor girls in participating in science fairs. Science fair committees at all levels beginning from the sub-county levels all the way to the national level should be advised to adopt gender equality and equity in selecting judges for different projects as a way of incorporating both male and female science teachers in the committees and in effect mentoring girls to take part in science fair as much as boys do.

4.6.4: Other strategies

From the questions 'what other strategies can be employed?' Plotted to the questionnaire respondents and 'what measures may be taken to promote both boys' and girls' involvement in

scientific fairs?' plotted to the interviewees, other strategies come up. For instance, it was suggested that science fair studies should be included in the syllabus or taught as a subject, this way most students will take it more seriously. Such responses did not however explain how science fairs will be separated from the other scientific subjects, or what aspects it will borrow from the other subjects. They also did not explain where teachers of science fair will be sourced from. It however looked like a strategy that can bear fruit if well planned for.

Based on the responses from the interviewee, science teachers, one said:

"*Lack of resources is a major challenge in achievement in science fairs. Resources can be in form of material such as the required things needed while undertaking science fairs. This one deters both boys and girls from participating. It can also be monetary such that if a school is poor, it may not sponsor students for expensive projects. Resources can also be in form of human resource. Some schools lack science teachers who are qualified enough to guide students in science fairs, yet some teachers lack enough knowledge to guide students in the right direction in matter science fairs. It can also be in form of time. Some science teachers have no time to guide students in science fairs*" (male science teacher and interviewee).

The utterance above imply that resources count a lot in participation in science fair, such that boys and girls may be limited to choose projects that their schools or parents can afford. Therefore, one strategy to counter this is for school institutions to invest in finding necessary resources useful for science fair competitions.

Another science teacher said this:

"If the administration does not support science fair, you cannot undertake a single project. There is an absolute need for the school administrative body to first support science fair for you to be able to carry out them" (male science teacher).

The place of the administrative body is therefore paramount in undertaking science fair. This implies that for boys and girls to take part in science fair, the administration must first be in support. The school administration therefore needs to be educated on the importance of encouraging participation of boys and girls in science fair competitions.

Another one said:

"*The most effective strategy is to encourage boys and girls have an open mind. Creativity is the engine of science fairs, without which a project cannot go anywhere. Science fairs aim to provide scientific solutions to world problems. Open-mindedness is key*" (female science teacher).

According to this science teacher, the main strategy to encourage boys and girls to participate in science fairs is help them be open-minded. The study similarly found this strategy necessary. Creativity can be grown through intensive reading, exposure to scientific plants and other useful happenings in the country and in the world too among other ways.

4.6.5: Summary of Strategies to Enhance Participation of Boys and Girls in Science Fair

From the findings, different strategies can be used to enhance participation of boys and girls in science fair competitions. The strategies were put in three broad categories and included emphasis on workshops to boost self-image and make boys and girls more assertive as they participate in science fairs. Concerning this strategy, the study suggests that government departments that are connected with sciences such as Centre for Mathematics, Science and Technology in East Africa (CEMASTEA) , Royal Society for Chemistry (RSC) and National Commission for Science,

Technology& Innovation (NACOSTI) among other bodies need to organise workshops and seminars aimed at improving the skills of students and science teachers in sciences and science fairs as well as boost the confidence of boys and girls in preparation for participation in science fairs. Such programmes would also see promotion of gender equity and equality in science fair participation and hence boost the participation of both boys and girls.

In addition, the strategy of creation of awareness on gender equality was also proposed. promotion of gender equality would help curb the stereotypical viewing of girls' involvement in science fairs, since findings of this study showed that participation of boys and girls in science fair has been stereotyped with the perception that boys are better in science fair and that they are better than girls when it comes to selection of technical and prestigious projects such as those that have to do with energy and transport or engineering. Gender equality will ensure that girls as well as boys are engaged equally in science fair and that they are portrayed in diverse roles in science and science fair. This would boost the participation of girls in science as data shows that they are quite few compared to boys, especially in Thika-west sub-county where the current study took place.

Role modelling and creation of mentorship programmes was the other umbrella of strategies proposed by the study. The study felt that there is need to create more women mentors as well as reward the available women role models in science and science fairs. The study showed that one reason for poor participation of girls in science fair is unavailability of role models from whom they can draw strength, lessons and ideas. For instance, the study showed that there are few female science teachers in secondary schools as well as few female science fair judges. The feeling of the study is that female students should be mobilised to take up science course, especially at the teacher training colleges to increase the number of female science teachers in schools. there was also a feeling that the available science teachers should be encouraged to take part in science fair

programmes so that they can mentor boys and girls in science fairs. As such, a comprehensive, multifaceted strategy that includes both men and women, girls and boys was seen as an overall strategy that fuel participation of boys and girls in scientific fair in the study area.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

The study's summary, conclusion, and suggestions are presented in this chapter. These are informed by the study's objectives and findings.

5.2 Summary of Findings

The first objective of this study sought to establish gender differences in the number of boys and girls involved in selected science fair competitions from 2012 to 2021 in secondary schools in Thika-west sub-county, Kiambu, Kenya. The study established that the majority of students involved in science fair competitions in Thika-west sub-county were boys and that few girls are involved in science fair competitions. Thus, science fair competitions in Thika-west sub-county are male dominated implying that science fairs have been construed as a male's undertaking. In terms of the kind of projects chosen for demonstration, boys and girls more often than not, choose similar projects ranging from technical projects such as those that have to do with energy and transport, engineering and, those on technology; to easier projects for example environmental and biological projects. However, boys do better in the technical projects while girls shine in the environmental projects. Therefore, despite science fair competitions being male dominated, girls are determined to outdo themselves and become as good as boys in science fairs. On the part of the levels reached in science fair competitions, both girls and boys have reached the highest level, the national level. However, more boys have reached this level more often. This implies that girls still lag behind in science fair competitions in Thika-west sub-county.

The second objective assesses the selection processes by schools for representation in science fair competition in secondary schools in the sub-county. The study found that majority of students who

participate in science fair competitions are selected based on their will and interest in taking part. This is important since students who join science fair out of their own volition and interest reported enjoying science fairs as well as daring to take part in challenging projects. However, a few others are selected by the science teachers based on those who the science teacher feels are good for which projects, while the fewest number is chosen by the school administration based on different school policies. Thus, the study found that most girls fail to participate in science fairs not because they have been denied the chance, though a few may be disadvantaged by the choosing done by science teachers or by the unfavourable school policies.

The third objective sought to establish the aspects affecting participation of boys and girls in science fair competitions in secondary schools in Thika west sub-county. These aspects include self-perception and stereotyping by the society, those related to the science fair environment such as few female role models in form of few female science teachers and science fair judges; performance in the fairs, which showed that boys and girls felt motivated to improve in their projects whenever they win at a certain level and feel discouraged whenever their projects lose; as well as lack of clear career paths in science which implies that students with clear careers in science tend to participate more in science fairs than those without. Other aspects were gender-related such sexual harassment and abuse, existence of social men's network through which boys tend to assist other boys in science fair projects, and existence of gender roles which place the girls at a disadvantage position. The study concluded that fewer girls participate in science fairs as a result of a variety of factors such as Gender-specific concepts, such as conventional notions about women's social roles, lack of role models, lack of career guidance, the assumption that women are less capable and sexual harassment. As a result, there is only a tiny number of girls competing in science fairs in the sub-county. According to the report, women are relegated to less respected and

underappreciated roles in scientific fairs in the Thika-west sub-county as a result of gender stereotypes and male domination in the area. This is seen to be fuelled by male's ambition to rule in science fair, which is thought to be an important beginning point in the technical management of science and technology. Due of the influence and financial support it carries, participation in science fairs is also seen as being of high rank and prestigious. Therefore, the study in addition notes that participation in science fair competitions remain male dominated due to the prestige and rewards associated with participation in science and technology.

The fourth objective identifies strategies that can ensure gender equitable participation of boys and girls in science fair competitions in secondary schools in Thika-west sub-county. In order to alter the traditional perception of a woman scientist, it was discovered that activities tailored to particular genders are required. The research revealed that this may be accomplished via organisation of workshops to boost self-image especially to the secondary school girls who have been socialised to believe that boys are better in sciences compared to them,creation of gender equality awareness whereby boys and girls will be encouraged to participate equally and equitably in all developmental opportunities including science, and conduction of role modelling and mentorship programmes to increase the number of women in the science field and in the science fairs in the sub-county and in Kenya as a whole, as well as other strategies identified by the study.

5.3 Conclusion

Based on the study findings and discussions in chapter four, the study concludes that, participation of girls in science fair competitions in Thika-west sub-county is lower than that of the boys. Secondly, there is fairness in choosing which students to participate in science fair competitions, whereby students are given the freedom to choose whether or not to participate and to choose which project they wish to undertake. Thirdly, there are several aspects that affect the participation

of boys and girls in science fairs in this sub-county. These include perceptions and stereotyping, science fair environmental aspects such as few role models, lack of clear career paths in science, and past achievements in these fairs. Other aspects are related to gender such as sexual harassment and abuse, existence of informal 'social men's network' in which boys help other boys in their science fair projects, and limitations by gender roles. The study underlines that gender roles and stereotyping are very harmful to women, often impeding their aspirations to pursue careers in science, through controlled participation in science fairs in secondary schools. Observably, girls face many challenges in their desire to fully participate in science fairs. Consequently, girls do not prioritize participation in technical science fair projects since they have been pushed to less prestigious projects such as home science and environmental projects which may not take them as far as where projects in engineering, energy and transport, and modern technology may take boys. Because of this, they frequently struggle to find the services and help they need to realize full participation in science fair competitions. The study findings also conclude that most girls tend to favour projects with less complex technical requirements. A few are satisfied with participation at this point. However, those who choose to venture to more technical projects face several challenges. Where there is presence of successful girls in technical projects, the belief that these girls are outliers rather than the norm is prevalent. Irrespective of their hurdles in participation in science fairs, this study reveals that girls are constantly asserting themselves as fully capable of participating in science fairs. There are girls who have reached the highest levels of science fair participation despite being trivialized. The research suggests policies that would provide women additional opportunities to participate in science and scientific fairs. These include Workshops to boost self-image, creation of gender equality awareness, and provision of role modelling and

mentorship programmes. With these strategies, it is expected that girl's participation in science fair competitions will increase as time moves on

5.4 Recommendations

Following the conclusions of the study, the following recommendations are made to address the participation of boys and girls in science fair competitions.

1. Secondary school boys and girls should endeavor to actively participate in science fairs to benefit economically and socially through innovation and scientific engagement.
2. Science teachers should promote gender equality and equity in schools.This can be done through portraying both boys and girls as capable in all sectors and hence foster inclusive participation in science fairs.
3. The Ministry of Public Service, Youth and Gender, and the National Gender Commission should ensure science fairs uphold gender parity through gender-responsive programs in accordance with the 2010 Kenyan Constitution and the 2000 National Policy on Gender and Development.
4. Organizations like CEMASTEA and SMASSE should run gender-sensitive campaigns, support women scientists, and enforce policies to prevent sexual harassment. This would encourage young women to participate in science fairs, as well as work to combat stereotypes about the capability and abilities of women scientists.
5. Ministry of Education, science and technology (MOEST) should implement mentorship, training, and sponsorship programs, and promote female science teachers as role models to inspire girls for involvement in science.

5.5 Suggestions for Further Research

- This study focused on gender as a determinant of participation of boys and girls in science fair competitions; it however did not assess other determinants such as home background determinants, school-based determinants and socio-economic determinants and hence further research is necessary to fully understand the situation in a broader picture.
- Since the study respondents were drawn from some selected secondary schools in Kiambu county, the effects found may entirely reflect the situation in that county. Hence, the findings may not be fully representative of all secondary schools in Kenya. Thus, this study needs to be replicated in other parts of Kenya in order to get a better picture of the situation in the whole country. This will facilitate better decision making as regards participation of boys and girls in science fair.

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APPENDICES

APPENDIX 1: QUESTIONNAIRE FOR STUDENTS

Dear respondent,

My name is Maureen Muthoki Nzusyo, and I'm a master's student studying gender and development at Kenyatta University. My study is on ‘Gender as a determinant of students’ participation levels in science fair competitions in secondary schools in Thika-west Sub-couty, Kiambu, Kenya.

I kindly ask you to set aside some time to completely and truthfully complete the questionnaire b elow. The supplied information will only be used for academic purposes, and will be kept confidential.

Thank you.

PART 1: DEMOGRAPHIC INFORMATION.

1. School name……

2.Your gender (tick one): i) female ( ) (ii) Male ( ) (iii) any other ……

3.Kind of the school (please tick one from each of the category below)

i. Boys ( ), Girls ( ), Mixed ( )
ii. National ( ), extra-county ( ), county ( ), sub-county ( )
iii. Mainstream ( ), special ( )
iv. Day (,) boarding ( )

4. Age……

5. Form level (please tick as appropriate)

Form one ( ), Form two ( ), Form three ( ), Form four ( )

PART 2: GENDER DIFFERENCES IN INVOLVEMENT OF BOYS AND GIRLS IN SCIENCE FAIR

6. Have you ever participated in science fair in your school? Yes ( ) no ( ). If no, proceed to question 7. If yes, what is your experience in participation? (You can choose more than one)

i. It boosted my interest in sciences ( )
ii. It boosted my self-esteem ( )
iii. It did not affect me in anyway ( )

7. Which students participate in science fair in your school? (you can tick more than one)

Girls ( ), boys ( ), any student ( ), depends with science teachers ( )

depends with school administration ( ) (please explain)…….

Any other…….

8. How many girls compared to boys participate in science fair in your school or subcounty?

(Please tick one): (i) (more girls), (fewer girls), (boys and girls participate equally)

9. What kind of projects do most students in your school undertake? (You can tick more than one)

Mathematics ( ), Chemistry ( ), Biology ( ), Physics ( ), Computer ( )

Home science ( ), All STEM subjects ( ), Depends with science teachers ( )

10. Do boys and girls undertake similar projects in your school or sub-county? Yes ( ), No ( ). If no, what projects do the following tend to choose?

Girls……

Boys……

11. (i) What is the highest level reached by your school in science fair? Please tick one

Sub-county ( ), County ( ), Regional ( ), National ( ), I have no idea ( )

ii) who reached that level? (Please tick one)

girls ( ), boys ( ), both boys and girls ( ), I don't know ( )

PART 3: SELECTION PROCESSES IN SCHOOLS FOR REPRESENTATION BY BOYS AND GIRLS IN SCIENCE FAIR COMPETITIONS

12. Who decides on the students to take part in science fair?

Administration ( ), science teachers ( ), students themselves ( )

13. What criteria is used to decide on who to take part in science fair competition?

Students' interest in science fair ( ), science teacher's choice ( ),

Depends with school policy ( ) . please, specify the policy ……

……

14. Who decides on the project to be undertaken for science fair?

Administration ( ), science teachers ( ), students themselves ( )

15. What criteria is used to decide on the project to be undertaken in science fair?

Students' interest in the project ( ), science teacher's choice ( ), administration's interest ( )

PART 4: ASPECTS AFFECTING PARTICIPATION OF BOYS AND GIRLS IN SCIENCE FAIR

16. How do you agree with the following aspects affecting boys' and girls' participation in science fair? (5-Strongly Agree, 4- Somehow Agree, 3-Neutral, 2-Disagree, 1-Stongly Disagree).

	5	4	3	2	1
1. Boys are seen as better in tackling physics projects					
2. Sexual harassment and abuse deter girls from participation in science fair					
3. Girls lack role models in the science field from whom they can draw encouragement					
4. Girls are seen as better in biological and home science projects					
5. Girls are pressurised to prove their capabilities in science					
6. Winning projects increase the credibility of both boys and girls in science fair competition.					
7. Boys compete more stiffly for win in science fair					
8. Boys will assist other boys in their science projects because of the existence of a "social men's network" that extends beyond the labor market.					
9. Boys are exposed to machines earlier in life giving them advantage over girls in science fair					
10. Lack of obvious career options prevent boys and girls from participating in science fair					
11. Defined roles of women and men in society work against girls' participation in science fair					

Any other aspect…….

Part 5: GENDER RESPONSIVE STRATEGIES FOR PROMOTING GENDER EQUITABLE PARTICIPATION IN SCIENCE FAIR COMPETITION

17. How do you agree with the following strategies to address the challenges faced by boys and girls in participation in science fair competition? (5-Strongly Agree, 4- Somehow Agree, 3-Neutral, 2-Disagree, 1-Stongly Disagree).

1. Change the stereotypical view of girls' involvement in science fair through public education					
2. Add women judges and adjudicators in science fairs to act as role models for girls who want to participate in science fair					
3. Conduct workshops on self-image for secondary school boys and girls to make them more assertive as they participate in science fair.					
4. Ensure that there is no gender harassment or prejudice at the science fair environment.					
5. SEMASTEA and Government Departments need to sponsor girls and boys to train on demands of science fairs.					
6. Engage girls and boys equally in science fair.					
7. Portray boys &girls in diverse roles in science fair.					

1 What other strategies can be employed to boost the situation?

_____

_____

APPENDIX II: INTERVIEW GUIDE FOR SCIENCE TEACHERS

Dear respondent,

My name is Maureen Muthoki Nzusyo, and I'm a master's student studying gender and development at Kenyatta University. My study is on 'Gender as a determinant of students' participation levels in science fair competitions in secondary schools in Thika-west Sub-couty, Kiambu, Kenya.

I kindly ask you to set aside some time to completely and truthfully complete the questionnaire b elow. The supplied information will only be used for academic purposes, and will be kept confidential.

Thank you in advance for support.

PART A: RESPONDENTS' DETAILS

1. Gender: female ( ), male ( ), any other ( ) please specify……..
2. Subjects taught (you can tick more than one)

   mathematics ( ), chemistry ( ), physics ( ), home science ( ), biology ( ), any other…….

PART 2: BOYS' AND GIRLS' PARTICIPATION IN SCIENCE FAIR COMPETITION

1. What is your opinion towards boys' and girls' involvement in science fair competitions?
2. Between boys and girl, who performs better in science fair in your school and/or subcounty? What are the likely reasons?
3. Do girls and boys choose similar science fair projects in your school and/or your sub-county? If not so, what kind of projects do each group tend to choose?

4. How do gender roles in traditional Kenyan society affect boys' and girls' involvement in science fair competitions?
5. Boys are generally more represented in science fair compared to girls. Is this the truth in your sub-county? If yes, what could have led to this state?
6. Are there girls who outdo boys in science fair competitions in the school or in your sub-county? How do they manage to overcome challenges and succeed?
7. How do how people perceive things in the society affect the participation of girls and boys in science fair and generally in science?
8. What are some other challenges facing boys and girls as far as participation in science fair competition is concerned?
9. What measures may be taken to promote both girls' and boys' involvement in scientific fairs?

APPENDIX 3: LIST OF SECONDARY SCHOOLS IN THE STUDY AREA

LIST OF SECONDARY SCHOOLS IN THIKA WEST SUB-COUNTY-2019

NAME	GENDER	CATEGORY	ABLE-BODIED/SPECIAL STUDENTS
1. Maryhill	girls	national	able-bodied
2. S.A. Thika	mixed	national	school for blind
3. S.A. Joytown	mixed	national	school for physically hand capped
4. Thika high	boys	extra-county	able-bodied
5. M-Pesa Foundation	mixed	private	able-bodied & special
6. Chania Boys'	boys	extra-county	able-bodied
7. Chania Girls'	girls	extra-county	able-bodied
8. Karibaribi	girls'	county	able-bodied
9. kimuchu	mixed	sub-county	able-bodied
10. St. David's	mixed	private	able-bodied
11. Broadway	mixed	sub-county	able-bodied
12. Thika Garrison	mixed	sub-county	able-bodied
13. Kenyatta	girls'	sub-county	able-bodied
14. Thika Girls'	girls	private	able-bodied
15. Queen of Rosary	mixed	sub-county	able-bodied
16. Blue Ribbon	mixed	private	able-bodied
17. Heights Academy	mixed	private	able-bodied
18. Pentagon Academy	mixed	private	able-bodied
19. Oasis Senior Sch	mixed	private	able-bodied
20. Appolonus	mixed	private	able-bodied
21. St. Marks	mixed	private	able-bodied
22. Theos Senior Sch	mixed	private	able-bodied

APPENDIX 4: LIST OF SECONDARY SCHOOLS IDENTIFIED FOR STUDY

NAME	GENDER	CATEGORY	ABLE-BODIED/SPECIAL STUDENTS
1. S.A. Joytown	mixed	national	school for physically handicapped
2.S.A. Thika	mixed	national	school for blind
3. Mary Hill	girls	national	able-bodied
4.Thika high	boys	extra-county	able-bodied
5.Chania Boys'	boys	extra-county	able-bodied
6. Chania Girls'	girls	extra-county	able-bodied
7. Karibaribi	girls'	county	able-bodied
8. kimuchu	mixed	sub-county	able-bodied
9.Thika Garrison	mixed	sub-county	able-bodied
10. Kenyatta	girls'	sub-county	able-bodied
11. Broadway	mixed	sub-county	able-bodied
12. Thika Garrison	mixed	sub-county	able-bodied
13. Kenyatta	girls'	sub-county	able-bodied
14. Thika Girls'	girls	private	able-bodied
15. Queen of Rosary	mixed	sub-county	able-bodied

APPENDIX 5: INFORMED CONSENT FORM

KENYATTA UNIVERSITY
OFFICE OF THE CHAIRMAN ETHICS REVIEW COMMITTEE

Informed Consent

My name is **Maureen Muthoki Nzusyo** and I am a Master student from Kenyatta University. I am conducting a study titled "**Gender as a Determinant of Student's Participation Levels in Science Fair Competitions in Secondary schools in Kiambu County, Kenya"**. The purpose of this study is to collect data which will help in understanding gender as a determinant of student's participation in science fair competitions in Kiambu County. Understanding gender as a determinant of students' participation in science fair is important as it helps to bridge gender gaps and inform policy and intervention design to enhance inclusive participation.

Procedures to be followed

Participation in this study will require that I provide a questionnaire which you will fill based on your knowledge of the questions asked. If you need any assistance in the interpretation of the questions, it will be provided.

Voluntarism

You have the right to refuse participation in this study. You are also at liberty to withdraw your participation at any level of participation or skip some of the questions if you so wish. Please remember that participation in this study is voluntarily. You may ask questions related to the study at any time.

Confidentiality

Your name will not be recorded on the questionnaire but will rather be anonymous. Similarly, your responses will remain anonymous, hence you won't face any negative consequences connected to your responses.

Contact Information

If you have questions about the study call Dr. _____ tel.: _____(Supervisor 1) or Dr _____(supervisor 2) Tel.:_____

However, if you have questions about your rights as a study participant: You may contact Kenyatta University Ethical Review Committee Secretariat on chairman.kuerc@ku.ac.ke,

Participant's statement

The above information regarding my participation in the study is clear to me. The study has been explained to me and I have been given a chance to ask questions and my questions have been answered to my satisfaction. My participation in this study is entirely voluntary. I understand that I can leave the study at any time. I understand that I will not be victimized in any way for refusing to participate in the study.

Name of Participant: _____

_____ _____

Signature or Thumbprint Date

Researcher's statement

I, the undersigned, have explained to the volunteer in a language s/he understands, the procedures to be followed in the study.

Maureen Muthoki Nzusyo (interviewer)

_____ _____

Signature Date

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **429196**

Date of Issue: **05/April/2023**

RESEARCH LICENSE

This is to Certify that Ms.. MAUREEN mutheki nzuyo of Kenyatta University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Kiambu on the topic: Gender as Determinant of Students' participation levels in science fair, competition in secondary schools in Kiambu County Kenya for the period ending : 05/April/2024.

License No: **NACOSTI/P/23/24734**

429196

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY & INNOVATION

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See overleaf for conditions