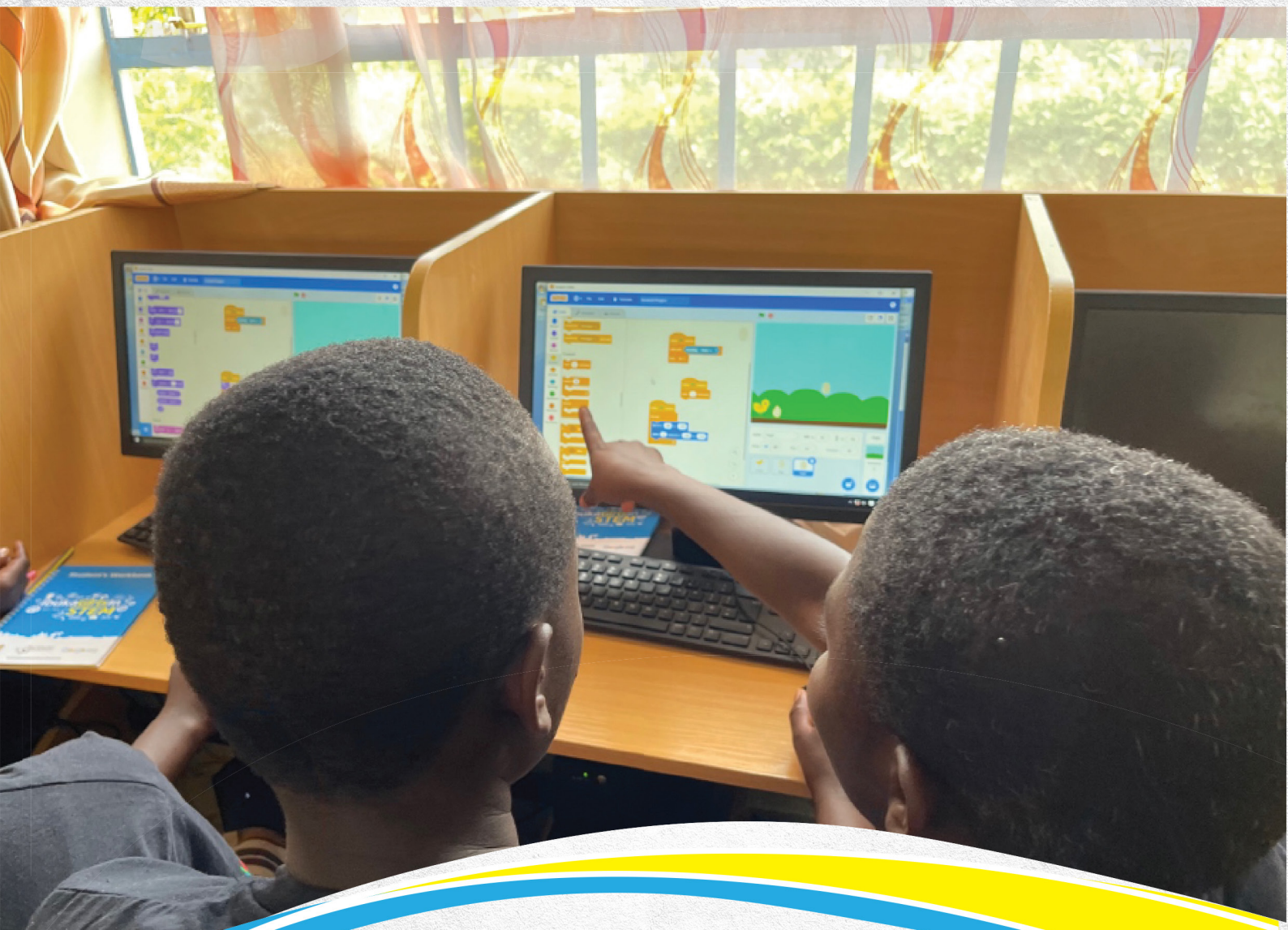
White Paper on Expanding Opportunities for Girls with Disabilities Through Mentorship in Science, Technology, Engineering, and Mathematics (STEM)



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Introduction and Background

The UN Women strategy on the empowerment of women and girls with disabilities - 2018 notes that women and girls with disabilities face multiple and interlinked challenges in realizing their full potential regarding their education, agency, and economic empowerment (UN Women, 2017). Girls with disabilities have the lowest education participation rates in the world in that only 1% are literate globally (UNICEF, 2018). Knowledge of STEM subjects (Science, Technology, Engineering, and Mathematics) is significantly deficient. In most cases, girls are less likely to get exposed to computers and technology at an early age than their male counterparts. This scenario contributes to limited interest in the STEM field (Plourde, Thomas, Bertone & Gates, 2020).

Young women and girls are less likely to succeed in math and science at all levels of their academic careers, leaving them underprepared to succeed in STEM fields at the undergraduate level (Ukoha & Rustagi, 2010). This digital exclusion hinders their active exposure to technology which can help reduce inequalities and unlock future economic opportunities. (CEMASTEA (2016). Kenya is implementing one of the most vibrant and world-class curricula ever. The Competency-Based Curriculum Framework emphasizes the importance of STEM as an education pathway. The country has also adopted the National ICT in education and training policy 2021 to bridge the technology gap in all educational settings.

Problem statement.

While the barriers to effective STEM education are well documented, there still exists a gap in information on the inclusion and participation of women and girls with disabilities in STEM-related subjects and careers. There is limited data on their participation in STEM-related subjects, career courses, mentorship, and weak infrastructure in learning institutions to support inclusive STEM learning. Despite the public-private effort to integrate technology into learning and improve access for women and girls, gaps still exist that limit the ability of women and girls with disabilities to enhance technology subjects and career uptake.

The Centre for Mathematics Science and Technology Education in Africa (CEMASTEA) was tasked by the Ministry of Education (MOE) Kenya to transform one secondary school in each county into a STEM model school. The implementation of this directive did not accommodate secondary schools that cater to students with disabilities. Research has therefore shown that compared to their peers, there is a significant mismatch between girls with disabilities' aspirations and their ability to access appropriate skills development programs, productive assets, and productive employment. Young women are underrepresented in technology-related education and jobs, and this is particularly the case for disabled women and girls. The resultant digital exclusion hinders active exposure to technology which can help reduce inequalities and unlock future economic opportunities.

Project description

The Action Foundation (TAF) was selected for the Google.org Impact Challenge for Women and Girls as part of our women and girls' empowerment program to expand opportunities for girls with disabilities in STEM. The Ibuka Girls in STEM is a 3-Year Project that seeks to empower girls with disabilities to create solutions for the problems affecting their daily lives through coding, robotics, mobile app development, virtual reality, science kits, and STEM competitions. This project is being implemented in partnership with The Ministry of Education – Directorate of Special Needs Education. As a result, the girls will gain relevant skills to confidently take STEM opportunities and succeed in the dynamic job market.

Project Objectives

This project aims to enhance the interest, skills, and knowledge of girls with disabilities in STEM-related fields for them to succeed. It also seeks to increase their chances of enrolling in these career fields and future employability. In order to achieve this, the project seeks to;

- Enable girls with disabilities (GWDs) to explore STEM learning areas and careers through guided mentorship and after-school STEM activities.
- Establish STEM Hubs in Special and Integrated Secondary Schools to advance the uptake of STEM among GWDs by providing the tools and environment to further STEM activities.

The Project Approach

A detailed methodology was developed to conduct an infrastructure audit and a baseline survey in 35 selected special secondary schools across 17 counties in Kenya. The activity was carried out between December 2021 and March 2022. The joint teams conducted observation visits to assess ICT and STEM infrastructure preparedness, met with key informants to learn about the school's practices related to STEM education, and reviewed the existing STEM interventions. FGDs were also held to gain insights into the needs, aspirations, and challenges of girls with disabilities.

In addition, the team designed school-based STEM boot camps for girls with disabilities. With guided engagement by their teachers and learning support assistants in activities such as robotics, coding, and mobile app development, the sessions provide practical skills and increase interest in STEM. Disability-inclusive STEM training manuals on coding, robotics, and mobile app development are under development and adaptation in partnership and policy guidance with the Ministry of Education- Directorate of Special needs Education and other relevant stakeholders. The manuals will then be validated, piloted, and submitted to the Kenya Institute of Curriculum Development for vetting and approval in all secondary schools in the country.

The project aims to capacity-build STEM and ICT teachers on how to ensure inclusive STEM learning, gender-responsive learning, and skills in coding, robotics, and mobile application development. This will enable the girls to use technology for problem-solving.

Further, TAF and MOE-DSNE conducted an after-school induction exercise that preceded the distribution of STEM equipment and materials. This resulted in equipping 35 schools with STEM equipment, materials, and other merchandise. After that, the teachers convened after-school STEM sessions to expose girls to skills-building sessions and provide space for them to interact, innovate, and create solutions with the equipment provided.

Support for infrastructure capacity and equipment of participating schools is a critical part of the protect design. The project team distributed various equipment that included, Smart TVs, portable internet devices, laptops, and robotics and invention kits; Lego Spike PRIME and Makey Makey invention kits to support STEM sessions in the schools.

Key Findings of the Infrastructure Audit and Needs Assessment

School Infrastructure

56% of schools had technology infrastructure such as computer labs, internet connectivity, and power supply, while **44%** did not. **90%** reported using obsolete devices. **81%** of the institutions lacked adapted furniture for reasonable accommodation for students with specific disabilities. There was an alarming practice of no defined e-waste management.

Teacher capacity

There was a mismatch between teachers' social and cultural values, their teaching practices, and the new shifts in STEM education. **68%** of the 30 teachers sampled lacked ICT skills to support STEM learning. Policies and practices in STEM education inspired **65%** of schools to adopt digital learning curricula per government directions. Teachers believed that the most critical interventions for STEM learning were infrastructure investments, teacher capacity enhancement, and STEM mentorship for girls with disabilities. The lack of adapted STEM-specific learning resources and materials continues to be an issue in classrooms

Student perspectives

From the Focus Group Discussions (FGDs), **60%** of the girls with disabilities were not aware of coding, robotics, and software development. The girls believed their most significant barrier to learning was poor infrastructure and inadequate assistive devices and technology—**85%** desired to join higher education, i.e., university or college. This feedback provides data on how Girls with Disabilities (GWDs) are disadvantaged in the innovation system and the limited opportunities to participate in innovation competitions as these are mostly given to boys.

Lessons learned

Mentorship enhances confidence and collaboration.

Mentoring girls with special educational needs and disabilities in STEM unlocks new and different opportunities. With STEM, they get a chance to learn effectively through creativity as they interact with different ICT devices. In addition, technology enables the development of innovative projects which foster critical thinking and collaboration. For example, in a class of students with visual impairment, we found that girls with low vision can help guide girls with total blindness manipulate different devices, encouraging teamwork and confidence as they engage in group work activities.

Innovation enhances learning experiences.

Girls with disabilities from St. Lucy High school for the Visually Impaired discovered that the Makey Makey invention kit enabled them to identify letters in a keyboard by knowing which letter each conductor represents

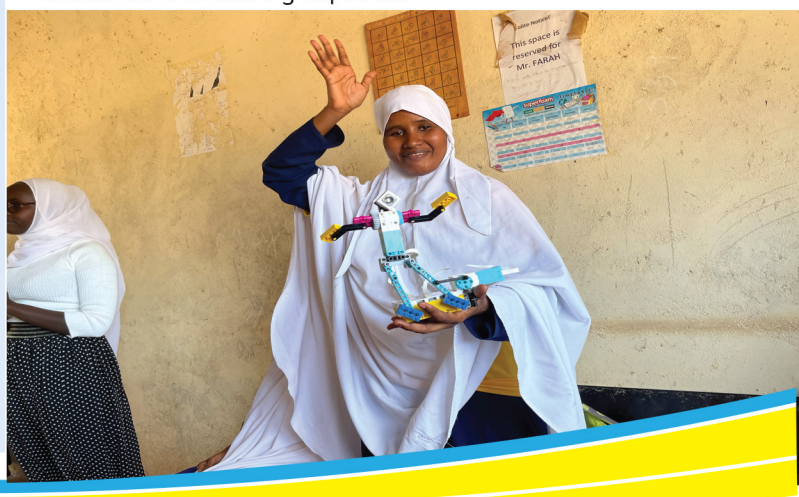
"Our students love music, and the Makey Makey invention Kit has been very interesting for them. They imported music they had previously created into the laptop and uploaded various tunes to their Scratch projects. Afterward, they incorporated the Makey Makey invention Kit so that they could make music using the kit. They are fascinated by how they can integrate simple materials like fruits and water to make music. It encourages and boosts their morale in navigating STEM areas" - **Nicholas Kimathi,** Ibuka Champion Teacher at St. Lucy High school for the visually impaired.

Appropriate infrastructure enhances learning and skills acquisition.

Providing digital infrastructure has been a game-changer to the project schools. Teachers can currently use Smart TVs, laptops, and other devices to deliver classroom content. In addition, this has led to the start of after-school STEM Clubs for the girls in forms one, two, and three. These clubs are beneficial because they provide a safe learning environment that boosts confidence and knowledge in STEM activities.

The after-school boot camps have also demonstrated great success as there has been a change of attitude in the girls with disabilities, who have gained increased confidence and interest in STEM subjects.

"Integrating ICT in teaching and learning will improve our student's performance since they now do not have to rely on the teacher only; they can also learn by themselves, which is much easier for them. In addition, providing them with these devices increases their classroom participation since they are fully engaged in class activities through research and creating projects rather than learning from the teachers" - **Tr. Maurice Arawo** from Fr. Ouderaa Special Secondary school for the hearing impaired.



Qualitative Experiences during after-school STEM clubs among girls with different categories of disabilities.

Visual impairment

This category of learners is particularly interested in all STEM activities that involve sound. For example, the majority had a deep interest in using Scratch Programming Language to create music projects, make sounds, and integrate the Makey Makey invention Kit into their Scratch Projects. This is because the kit size is relatively small and can be easily manipulated by the sense of touch.

Girls with low vision could manipulate and go through the lessons with adequate guidance on how to use the devices. In general, empowering these girls to understand different accessibility functions that can improve their quality of life goes a long way to encourage learning using ICT tools.

Hearing Impairment

Robotics sessions were found to be the most popular among hearing-impaired students. The sessions were self-paced, where the use of open educational resources from the Lego Foundation enabled the students to follow steps using pictures that helped guide them on how to join the different parts of the robot step by step. The girls could go through these activities independently, requiring little or no help. Their excitement was evident when their robot moved at the end of the session and sensed different things like touch and light. Creating something from simple blocks to a robot is significantly rewarding. As long as the girls are guided on how to go through the activities, they can learn and collaborate to create different projects.

Physical impairment

Some girls with physical impairment found it challenging to maneuver the laptop because of the small keys on the keyboard. The Makey Makey invention kit helped the students extend the keys and manipulate the laptop keyboard like other students.

Intellectual Disabilities

Students with mild intellectual disabilities were mainly interested in short and fun activities. This helped boost their morale as they could complete activities faster. We found out that it is best to break the content of longer sessions and concepts into smaller lessons so that the students can grasp the content bit by bit.

Call to action.

1. Adapt digital content/ STEM learning to suit the needs of learners with different categories of disabilities. Developing adequately differentiated manuals is a crucial consideration.
2. Provide inclusive ICT digital devices to enhance learning for girls with disabilities.
3. In addition to ICT devices, provide assistive devices, and technologies such as orbits readers and talking calculators to enhance learning experiences.
4. Create opportunities for exposure to STEM-related careers for adolescent girls with disabilities through job shadows, career mentorships.
5. Support skills acquisition through a disability-inclusive post-secondary transition pipeline into STEM career pathways.

Conclusion

In our preliminary findings, students' and teachers' enthusiasm and determination to engage in STEM activities prove what happens when opportunities are provided to girls with disabilities and the community that supports them. As the project pioneers STEM education for girls with disabilities, this significant first step will go a long way in shaping the future of girls with disabilities in STEM careers. Indeed, girls with disabilities can succeed in STEM subjects and careers if given the proper support and opportunities!

STEM has been included in the overall national agenda and has been well-accepted by critical stakeholders. The Kenya Basic Competency-Based Curriculum Framework emphasizes the importance of STEM as an education pathway. There is, therefore, a need to invest in more STEM-based programs with holistic support for girls with disabilities. Multi-stakeholder engagement is a fundamental factor for successful STEM project implementation in terms of holistic support for girls. Improving coaching programs, career guidance, and exchange programs are all key aspects to be addressed in any successful STEM project implementation. In addition to teachers, parents must be supported to mentor and cultivate girls with disabilities' interest in STEM.

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