

A Plugin Campus for Computing in Africa: An Analysis of Five Years

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Abstract—This innovative practice paper describes Academic or institutional change for Graduate Education. Africa is a continent filled with unutilized young talent. This is due to several factors such as limited access to quality education, especially in engineering and computing. A plugin campus refers to a mini-branch or remote campus of a base university (usually from the Global North) that operates in another country (usually in the Global South) at the host university's campus. We report an analysis of a case study, where the University of Turku ran its plugin campus at the University of Namibia during 2019-24. Its main aim was to offer studies especially in computing, but also to be a catalyst for the University of Namibia and to co-design digital solutions for African challenges. We report how, throughout its operation, the plugin campus has interacted with various individuals and significantly impacted the lives of many. It has identified and trained local talent that otherwise cannot afford to get any education in computing. The five most important lessons learned are that computing and more widely engineering education have to (1) listen to and learn from the local community's demands, especially by the young people, (2) recognize and support talent beyond formal education, (3) adapt to different cultures for better and mutual learning, (4) rethink the traditional educational models of the Global North to better fit different expectations of people, and (5) dedicate time to and trust to build local partnerships for making a difference in people's lives.

Index Terms—education; plugin campus

I. INTRODUCTION

A. Academic landscape in Africa: a brief overview

As noted by Stanley, the United Nations (UN) projects that by 2050 the African population is estimated to be around 2.5 billion which would be more than 25% of the world's population [1]. Africa currently has the youngest population in the world with 70% of sub-Saharan Africans being under the age of 30 [2]. This means that Africa necessitates forward-thinking schools and programs to help the young learn, prepare and do well in life.

African universities can be linked to overseas universities to ensure quality by giving a degree from the international partner [3]. This helps African students to get a similar quality of education as students in other countries. Many Namibian HEIs, in particular, struggle with limited finances, outdated teaching methods, and bureaucracy. Matondo says that “effective quality assurance systems are seen as pivotal in enhancing educational outcomes and institutional performance” [4].

Namibia's higher education institutions (HEIs) face huge problems with their ability to provide quality education and meet the demands of its young population. One of their biggest challenges is skill shortage with many graduates not having the required skills for industry which leads to high unemployment rates among young people [4]. Namibian HEIs are therefore encouraged to change their curricula so they meet the demands of industry to address the skill gap.

In the 22nd Annual Global CEO Survey by PWC in 2019 [5], it was found that 87% of African CEOs expressed worry regarding the availability of required skills, with 45% stating they were “extremely concerned”. This is higher than the 79% of global CEO's who shared similar concerns about skill availability in Africa. Among CEOs in Africa who were greatly worried about finding the key skills, 65% said they could not innovate well due to the shortage of skills, compared to 55% globally. Additionally, 59% admitted that their quality standards and customer experience suffered because of this, compared to 47% globally.

With Africa's population growing quickly and many young people expecting jobs and the skills to do those jobs, plugin campuses offer a potential solution. These campuses bring advanced training and resources to Africa by working together with universities from other parts of the world. By improving education with plugin campuses, businesses can improve their effectiveness and innovate more. This makes plugin campuses crucial for helping Africa's economy grow strong and helping young people succeed in their careers. This is not only limited to countries in Africa but to any developing country.

B. Setting up a plugin campus

A plugin campus is a particular type of remote campus where one university (base university) sets up a small campus inside another university (host university). The smaller campus works on its own but uses the host university's buildings and equipment. This setup is designed to improve education and offer novel ways of learning at the host university without competing with it [6]. It makes education better for everyone involved and shows how universities in various parts of the world can work together closely. This setup allows students to stay in their home country while getting exposure to a different education.

In 2019 the University of Turku (UTU) in Finland set up its first plugin campus outside of its own (base) country, with the University of Namibia (UNAM) in Windhoek hosting the plugin campus. The two universities agreed to use part of UNAM's main campus for this, which was designed by UTU to meet its educational standards. The new campus aimed to offer education, carry out research, and impact the community. It was not only to serve Namibia, but the whole of Southern Africa. Namibia was chosen because of its political stability, good facilities, and long history of co-operation between the two countries. The campus was active from 2019 to 2024.

The plugin campus was expected to train software engineers to an international standard and help Namibia rely less on foreign work and services [6]. It was also intended to help grow UNAM. The plugin campus was expected to attract young people from Namibia to bring innovative ideas and perspectives to UTU as shown in Figure 1. Both countries were interested in doing more research together on wicked problems like climate change and water shortages. The idea even led to the "Beyond the Imaginable Technologies for Sustaining Remote Life" (sites.utu.fi/bittip) research project on shared academic experience, which was funded by the Academy of Finland.

II. BACKGROUND: RELATED LITERATURE AND KEY CONCEPTS

The idea of a plugin campus is key to solving educational problems in Africa, especially in the technology and engineering fields. Unlike a standalone university branch like Carnegie Mellon's University-Africa in Rwanda, a plugin campus is a part of a larger flagship university based in a developed country that has been set up within a local university in a developing region. The plugin campus works autonomously but also closely with the local university, sharing resources and helping to create strong networks for knowledge exchange and starting local innovations.

Currently, there are several overseas campuses, set up in a variety of ways, in eight African countries. These setups range from hubs aiming at encouraging regional collaboration, to HEIs mainly offering their degrees in the host countries. Some of these offer degrees that are specially designed to meet local requirements, pioneering different ways international higher education can be implemented in Africa.

Plugin campuses are particularly good at showing how to use what is learned in classrooms to solve real-world problems. They encourage projects where students and teachers work together on local issues, making sure the education they provide fits well with the demands of the local job market and community. The approach not only makes education more relevant but also prepares students to use their skills effectively to help their communities.

Overseas campuses play a significant role in connecting global educational resources with local expectations. By getting students involved in projects focused on helping their communities, these institutions help students understand the local challenges better and use their education to make a

positive difference. The involvement builds a sense of responsibility among students and encourages them to use their skills for the good of the community, not just for personal success.

The Computer Science Curricula 2023 report offers useful insights into competency-based curriculum design [7]. It emphasizes that competency models complement rather than replace knowledge models, with competencies defined as the application of knowledge, skills, and dispositions in professional contexts. The report maps competency areas such as Software, Systems, and Applications to requisite knowledge units and topics. It also identifies authentic workplace tasks, competency statements aligned to those tasks, and the associated skill levels required to perform them. This competency-knowledge-task mapping bridges the gap between knowledge and competencies and combines conceptual learning with practical application.

Competency-based curriculum design is gaining prominence in education spheres, focusing on developing abilities to apply skills to real-life situations. Rychen and Salganik (2003) define competency as "the ability to successfully meet complex demands in a particular context" [8]. Competency-based learning outcomes provide a holistic development plan focused on cultivating not just knowledge but also the skills, attitudes, and values necessary for professional excellence. The emphasis on application makes this approach well-suited for contextualized education, making sure that students are not only knowledgeable but also capable of effectively using their skills in specific, real-world scenarios.

There is a noticeable gap that persists between academia and industry, resulting in graduates facing challenges in securing employment because of inadequate skills. Ruwodo et al. (2022) identified the following key factors contributing to this gap [9].

Faculty unawareness: faculty training objectives and current industry requirements often do not align, in part due to a lack of significant and effective collaboration between university faculty and industry.

Unrealistic projects: many student projects lack real-world applicability as they are not rooted in genuine practical problems or do not involve stakeholders.

Resource constraints: some universities lack essential resources, such as powerful computers, hindering students' ability to effectively develop software.

Absence of career planning: career planning is often neglected in the curriculum, leaving students ill-prepared to understand industry demands and the software engineering profession.

Limited cooperation between universities and industry: universities may not collaborate with industry to update their curricula according to current industry expectations.

The disconnect between academia and industry leads to various challenges. First, students often lack a comprehensive understanding of future careers, employment opportunities, and business requirements, which hampers their professional development. Secondly, there are deficiencies in critical soft skills like environmental cognition, engineering practice abil-



Fig. 1. Students interacting with each other in the plugin campus

ity, innovation consciousness, and teamwork spirit, all of which are essential for success in the workplace.

III. RESEARCH DESIGN

Research problem. An increasingly critical challenge in today's higher education, globally, is that of designing meaningful and functional schemes for developing countries. This is particularly true in the African context. The existing models that are imported from the Global North in most cases do not align well with the different challenges and opportunities found in Africa. This could lead to a design-reality gap in the African education sector. That is why it is important to create a novel way of doing things that integrates the local realities and the demands of the people.

The patterns and schemes imported from the Global North do not easily adapt to the demands of the African continent but enforce higher education practices that may not even work in their original setting. An example is game design, where most, if not all, successful young entrepreneurs and startups have built their knowledge, skills, and dispositions by themselves, informally or non-formally. In some cases, conventional academic training might even be considered a demerit for a prosperous career as a game designer. The same might be said of the success stories of Hollywood.

African higher education also has problems of its own. Public schools, where future students in higher education come from, can suffer not only from large classes or lack of learning materials but also from incompetent teachers or those who are too dependent on instructions from principals and do not dare to apply their professional skills in their classrooms. University curricula follow those of the (so-called) top universities outside of Africa, in theory, but not necessarily in practice. Collaboration with industry, beyond university campuses, is rare. Curriculum reforms typically follow outdated and authoritarian administrative processes that make them slow and inefficient. The courage to be African, with strong academic self-esteem, is missing.

Research questions. The challenge above is far from an easy-to-solve one, if only in a single discipline. In what follows, we present a case study on a five-year initiative where a European university set up a remote campus in Africa, focusing mostly on computing education. While the original agenda was to offer an MSc degree contextualized for the African setting, the COVID pandemic forced a change in direction towards, on the one hand, doctoral studies, and on the other hand, research-oriented community impact initiatives.

Therefore, in this case study, we wanted to look deep into the five years of the plugin campus and find answers to the following questions.

How does the plugin campus transform the way that engineering, especially computing education, is carried out in an African setting?

How does a plugin campus operate on the ground, within communities, outside a conventional university environment?

What kind of learning community does the plugin campus promote or require?

What kinds of technologies does the plugin campus make use of?

Research data and analysis. As this is a qualitative case study, no hypotheses were made, instead, the story of the five years was collected, analyzed, and interpreted. The data for this study were collected from a wide range of sources including notes, photos, interviews, publications, and news, and the remote campus's website summarizes the experiences from the whole period. The findings come from working closely with people and talking to them, performing interviews, doing co-design, observing participants, and case study analysis. A detailed narrative of the five-year period emerged, providing a nuanced understanding of the experiences and events that shaped this journey. Additionally, we are working on a manuscript on the lifespan of the plugin campus by the time of this writing.

IV. FINDINGS

The findings are organized into four main parts: Transforming as Academia, Co-designing within Communities, Making a Difference for Individuals, and Working on Technologies. The findings show how updating traditional educational methods, supporting individual growth, and developing new technologies, can significantly impact learning and community involvement. These updates and developments are extremely important in making education more relevant in today's rapidly changing world. They demonstrate that it does not require a large group of people to make a noticeable difference in how people learn, grow, and connect with others. Universities are required to change to meet today's expectations, which are driven by international and local demands, changing work environments, and the technologies and lifestyles that young people prefer. When universities focus solely on maintaining their elite status by using rigorous entrance exams to select their students, they are losing many bright, talented minds to more inclusive and innovative schools. Many have mentioned



Fig. 2. Community and University members meeting under a tree at a village near Khorixas

that education must change, but few have dared to take the steps to make the change happen.

A. Transforming as Academia

Transforming academia involves rethinking traditional educational methods to better fit with the current demands and technological advancements. Different educational models like the plugin campus and UniGround aim to make education more accessible and practical in developing areas. These highlight the importance of adaptability and listening to local demands.

1) *Plugin campus as a physical university campus.*: Unlike standalone campuses, such as Carnegie-Mellon University in Rwanda, the plugin campus embodies a novel approach to education. Rather than occupying a dedicated building, the lab seamlessly integrates into the host university's main campus, leveraging its facilities and resources. The "plugin" model enables the lab to be easily embedded in diverse settings, from rural villages to corporate environments. A plugin campus always serves a given function. The mission of this plugin campus is to pioneer the design of technologies and applications that will impact Africa's future, driving meaningful change and progress.

2) *UniGround.*: The "University on the Ground" is an innovative approach to education bringing learning directly to the people in developing countries. It mixes practical training with university education in a way that caters to the strengths and interests of each learner. Instead of full degrees, it offers shorter courses called micro-credentials leveraging relevant technologies to enhance the learning experience. It has been piloted in Namibia to help skilled individuals who lack formal education to reach their goals. In 2023, the remote campus was discussed at the office of the European Commissioner for International Partnerships with plans to start a pilot school in Africa for five years. The school would identify talented individuals from disadvantaged areas who have not attended

school and equip them with the skills necessary to compete on the global stage.

3) *Fellowship as modus operandi.*: In stark contrast to traditional university settings, the plugin campus operated under a unique leadership paradigm. Rather than adopting a top-down approach, the campus was jointly led by two individuals from diverse backgrounds: an experienced professor from Europe, serving as director, and a young student from Africa, acting as campus coordinator. This unlikely duo brought distinct perspectives to the table, allowing them to tackle challenges from multiple angles. As a result, they fostered a strong familial bond and established a large network of local connections, including traditional authorities, local experts, and international connections like international researchers and diplomats. Notably, the plugin campus empowered young minds by taking their innovative ideas seriously and transforming them into tangible initiatives, such as a community development project to help disadvantaged communities in one of the poorest regions in Namibia which was conceived by the campus coordinator.

4) *Reforming the curriculum.*: The process of updating the curriculum at traditional universities is usually long and complex, often making it difficult for universities to meet learning expectations. The plugin campus worked with UNAM to revamp UNAM's software engineering course, offered a digital theology course, and suggested a new program in game design. These courses and programs emphasized practical work, relevant assessment, and strong industry ties. As a result, students could engage in practical projects, and even explore entrepreneurial ventures while pursuing their studies, fostering a more dynamic and relevant learning experience.

B. Co-designing within Communities

Co-designing with communities shows the importance of collaboration between universities and local people. This approach ensures that research and development projects are relevant to the demands of the people they serve. Working towards mutual trust and active participation and co-design work leads to more sustainable and impactful outcomes, closing the gap between academic knowledge and real-world application. Work by White et al. (2023) has identified multiple demands of communities but most importantly the necessity for a 'safe space' where members can share their ideas [10].

A plugin campus links the university to the community and seamlessly integrates research and development. That's why it is important to co-design and co-create research with local communities. Co-design is a method where researchers integrate themselves into the community, build trust over time, invite local members to participate in design meetings and work together through the entire process. Input from anyone is valued regardless of their age, background, or expertise.

An example is the community of Khorixas as shown in Figure 3, where the plugin campus engaged deeply in co-design activities. Khorixas is in the Kunene region which is one of Namibia's most disadvantaged region with the country's highest youth unemployment rates [11]. Understanding and



Fig. 3. Community members working in their gardens

empathy are essential in co-design, especially in marginalized communities where people might lack self-confidence. Not only does it show the importance of group counselling but also individual support to build self-esteem and encourage active participation.

The plugin campus was able to work with a small community in Khorixas with a group of international students as part of a sustainability development course to better understand local young people's problems and help them develop their business ideas. The campus also worked with the street engineers, a group of informally educated engineers to grow their toy manufacturing business and incorporate technology into their products.

Support from both traditional authorities as seen in Figure 5 and political authorities is pivotal for successful co-design. In Namibia, for instance, traditional leaders often represent community voices, while political figures help align projects with larger governmental goals. Figure 2 shows how community members gathered with the support of their traditional authority to make their voices heard. The plugin campus has experience from both sides, such as from the Gaob (king) of the Damara people and the Minister of ICT, who have been actively interested and supportive of the campus initiatives.

To ensure the success and authenticity of projects, they must originate from the people themselves and are facilitated by someone who shares their language, culture, and background. This approach fosters trust and open communication, leading to more effective and sustainable outcomes. A prime example is the community development initiative in Khorixas, which was conceptualised by the campus coordinator, a member of the same ethnic group and fluent in the local language. Similarly, in Opuwo, the street engineers, who had been crafting toy cars for years, sought collaboration to integrate robotics into their creations, demonstrating the value of local ownership and collaboration in driving innovation [12].

C. Making a difference for individuals

With limited resources and a small team, the approach was centred around creating a significant impact at an individual level. The underlying principle was that by influencing a select few, their ripple effect could be amplified, leveraging their strong relationships and community connections to drive meaningful change.

Identifying and empowering individuals. Identifying individuals who can thrive in an unconventional academic environment within their native country poses a significant challenge. It is largely due to fear and skepticism, not only among students but also among their families and friends, who play a crucial role in the learning process. The 12+ individuals who had been successfully identified and collaborated with were discovered through a grassroots approach, involving extensive travel, community outreach, and chance encounters. Our informal student recruitment approach differs from traditional methods of selecting students through formal entrance examinations for those qualified to apply by their high school certificates. It is based on the learners' explications of their future passions and expectations and evaluation of their learning potential, rather than the evidence of their former learning results.

Counselling. Many programs only focus on immediate requirements when working with developing communities and forget about the highest level in Maslow's hierarchy of needs. Lack of self-actualization and esteem leads to the program's failure once external funding stops. Our approach emphasizes the importance of building self-confidence and encouraging initiative, which is important to long-lasting projects led by the community.

The BauStead residence. The plugin campus director's and coordinator's home were more than just a home. It was a center for new ideas and community involvement where some of the learners were residing over periods from a few weeks to a few years. Known for its team spirit and shared meals it reflected a mix of modern design principles and African community life. The place encouraged creativity and showed how to include a personal touch in educational methods because people live together and have social gatherings.

"The lab showed me that I'm not too stupid for anything. It helped to find abilities within myself that I didn't even know existed." This feeling was echoed by many residents, who explained how the environment encouraged self-discovery and confidence. "The plugin campus was a place where young students and other creatives came together to collaborate and share ideas, especially computer science students. It was sort of a gateway for graduates who wanted to continue their studies." This is important in closing the gap between theoretical education and practical application.

The home incorporated the principles of the Bauhaus design school, such as the unity of art, craft and technology, the use of modern materials and technology and collaboration and interdisciplinary work. Most importantly it adopted the Bauhaus unique educational approach, mixing theoretical ed-

ucation with practical projects [13]. At the same time, it got inspiration from the African homestead structure, which is made for communal living and functionality.

D. Working on Technologies

The plugin campus prioritised the development of novel technologies and the optimization of existing ones. However, this endeavor has faced obstacles, including the traditional orientation of the Computer Science program at UNAM and the constraints imposed by the COVID-19 pandemic, which has hindered researchers' ability to conduct prolonged investigations. As a result, online meetings were a necessity, facilitating collaboration and research despite the challenges.

1) *Remote presence*: Funded by the Academy of Finland, the team developed technology that uses virtual reality and holograms. Remote presence technology has the potential to transform the educational landscape by creating immersive learning environments where students can interact with their peers and instructors in a shared augmented space, regardless of physical location. Unlike traditional online classes, this technology simulates a shared physical presence, fostering a more engaging and interactive learning experience. The development of this technology requires advanced programming expertise and a high-quality Internet connection [14].

2) *Metaversity*: Based on our remote presence technology, the team has been working on a "Metaversity," which is a university in the metaverse [9]. It mixes online learning with real-life experiences, making it feel like students and teachers are meeting face-to-face. It would remove some educational barriers like transportation costs, maintaining school buildings, and looking for good educational staff.

3) *Robotics*: Was taught using a hands-on approach, helping students learn about mathematics, physics, and programming. The robotics workshops offered were fun and exciting for learners from different schools from preschool to university from all over the country. These workshops introduced students to the world of Science, Technology, Engineering, Art, and Mathematics (STEAM) and encouraged them to think beyond traditional careers like accounting or medicine [15].

V. DISCUSSION

A. Findings in the light of literature

The lessons learned can be applied by other educational institutions to listen to local people and incorporate listening and working their demands into their curriculum. Making sure that student activities are practical and benefit real people is extremely important as this will improve student's real-life skills like problem-solving. International collaboration is also important as it allows universities to learn from each other, do joint research and help students understand international challenges and how solutions from other parts of the world can be adapted to their part of the world. The practical and hands-on way of the plugin campus addresses the skill gap mentioned by the CEOs in the Annual Global CEO Survey. When students work on real-life projects in demand, it increases their knowledge and understanding of the skills required in

industry [16]. Industry itself can be viewed as a community and students working with industrial partners get relevant skills. Community and industrial partnerships were formed by listening to each other's demands and expectations and finding ways to work together sustainably. It is important that all parties involved feel heard, respected and part of the whole process. The plugin campus adopted a practical competency-based approach to education through the UniGround approach, opting to first learn the context of the student and then provide them with the skills required to accomplish their goals. For example, with the Opuwo street engineers, a visit to their hometown and workshop allowed the team to understand their environment, during which they proposed a project, integrating robotics into toys as seen in Figure 4. The material required to educate them to achieve this goal was then co-designed so they had a real stake in the process allowing them to acquire the competency required to turn their dream into a reality. This approach follows the CS2023 guidelines while contextualizing them [7].

The industry-university gap was reduced as UTU provided the resources for learners to be exposed to industry-level tools such as remote presence and robotics. Through collaborative project development with local communities, learners acquired industry-ready skills and clear career paths, addressing the concerns raised by CEOs in the Annual Global CEO Survey regarding the availability of necessary skills.

Working with small communities like Khorixas, where local young people were encouraged to work on sustainable ways to get income like starting their business, and the street engineers growing their businesses in Opuwo and wanting to incorporate new technologies into their production and products, are just some examples of what the plugin model can achieve. Street engineers and other students continuing their studies abroad and completing PhDs are another examples.

The plugin campus pilot project successfully demonstrated the efficacy of this innovative approach, despite facing challenges, including identifying willing participants using unconventional methods, such as travelling to remote locations. Another hurdle was overcoming learners' initial skepticism, stemming from their familiarity with traditional university structures. Building trust within the community was crucial to overcoming these obstacles.

B. Shortcomings

For a case study, systematic documentation and a rigorous analysis of the data would have made the findings easier to derive and interpret. For this study, we were required to struggle with unstructured and even ad hoc data, like photos taken on the road. However, due to the dynamic or even improvised nature of our work on the ground, we prioritized piloting and adapting to the unexpectedly emerging opportunities at the grassroots at the cost of a more structured and hence planned approach. Our approach, however, was aligned with our emphasis on informal and non-formal learning: we figured out that while formal schooling does not serve to learn the skills of, say, mathematics, informal learning, like that of the



Fig. 4. Street engineers incorporating technology into their toys

street engineers in Opuwo, inspired them to learn what they required for designing and manufacturing their toy cars or managing the finances. We also realized that in disadvantaged communities, the strict separation between primary, secondary and tertiary education does not always serve the learning requirements. To redesign engineering education in the Global South to make it more relevant, a courageous piloting approach is essential. After the pilot stage of the plugin campus, it will be easier to start documenting the events and collecting the data, especially when we can work with communities with which we know each other and share mutual trust.

C. Recommendations to Practitioners in Engineering and Computing Education

1) Computing and engineering education must listen to the local community's demands: Education is called to pay close attention to what people on the ground or in local communities, especially young people, have to say about their expectations. We worked directly with communities to understand their hardships, making what we did and learned more relevant and practical. For example, we co-designed solutions to their agricultural problems using technology and indigenous knowledge. This has not only made education more applicable but also engaged students in meaningful ways.

This way of doing things has shown how listening to the communities' demands can change education by making it more responsive and dynamic.

2) Recognize and support talent beyond formal education: Recognizing and supporting non-traditional talent is essential. Many people do extremely well outside of the traditional classroom environment and have valuable skills that can contribute to their communities. For instance, the street engineers we encountered hadn't gone through formal training, but they applied engineering knowledge very skillfully. By finding and supporting these unique talents, educational systems can empower a wider range of the community promoting success, innovation and creativity that might be overlooked otherwise.

3) Adapting to different cultures for better and mutual learning: Changing educational content to be respectful and include local cultures is important for involving students. Inclusion helps students connect more deeply with their education by seeing real-life situations relevant to their lives and cultural experiences. For example, incorporating local knowledge and addressing community-specific issues such as agricultural challenges make sure that what is being learned is not only theoretical but also practical and valuable to the learner. Rethinking traditional models from the Global North or the industrial era to better suit different contexts is important. Removing entrance exams and fixed classroom settings can make education more inclusive and accessible for anyone willing to learn. Changes like these can invite a wider range of different talents into educational opportunities, ensuring that the learning environment is welcoming and supportive for students from diverse backgrounds.

4) Rethink the traditional educational models of the Global North to better fit different expectations of people: Contextualization, finding the right people and creating an environment for these people to grow is important for the success of the plugin campus. Listening to what they demand and willingness to be flexible is extremely important. The plugin campus made use of new technologies by introducing them to people who required them the most in a way that was relevant to them. For example, educational robotics was introduced to the school to help students with Science, Technology, Engineering Art and Mathematics education (STEAM) which was a bit of a problem in the current education system.

5) Dedicate time and trust to build local partnerships to make a difference in people's lives and their communities: When working with people time has shown the importance of building strong and trust-based partnerships with local communities and organizations. Building these partnerships may take time but are critical for the success of education. These partnerships should have respect for local demands but also resources and contributions, making sure that all parties benefit from them. By committing time and listening to the community's input, educational initiatives can create impactful and sustainable results that are beneficial to all parties involved. This integrated approach to education creates a learning environment that is not only about passing on knowledge but also about creating spaces and relationships



Fig. 5. Co-designing with Damara Royal Family in the plugin campus

for both the individual and the community.

VI. CONCLUSION

In the study, we explored the real-life data collected from various activities of the plugin campus. First and foremost, we wanted to understand the contributions of the scheme to rethinking engineering, especially computing education, in the Global South. We can summarize our findings by the four research questions as follows.

How does the plugin campus transform the way that engineering, especially computing education, is carried out in an African setting? The plugin campus transforms engineering and computing education in Africa by changing the traditional way of education to meet local demands as UniGround, co-designing solutions with local communities, and using practical and real-word approaches, make sure that the education is relevant, accessible to anyone and addresses the demands of the local people.

How does a plugin campus operate on the ground, within communities, outside a conventional university environment? A plugin campus operates on the ground by integrating itself into local communities and working directly with the members. Co-designing projects with local communities, providing practical training, and supporting ideas, address local problems.

What kind of learning community does the plugin campus promote or require? A plugin campus is an instantiation of thinking small rather than big. It identifies and focuses on talented individuals rather than mass education, so allowing for personal counselling and individual growth. As BauStead, it merges the European Bauhaus model of a design school with the African extended family house, homestead.

What kinds of technologies does the plugin campus make use of? We identified remote presence, metaverse and robotics as promising technologies to realize a plugin campus, or even a distributed network thereof. This means that a small academic unit does not always require to plug itself into a traditional

host campus, but any infrastructure that offers it the resources that it requires.

The findings led to a set of five recommendations that we collected to re-design engineering education. The recommendations can be juxtaposed with the four dimensions of competency-based education, a task to be carried out in the future. To give an example, though, recommendation No. 1, i.e., “Computing and more widely engineering education has to listen to and learn from the local community’s demands, especially young people”, requires knowledge of a given community, skills to communicate and work with them, and a curious and respectful disposition to people that might have a very different culture to that of the outside learner.

Our study invoked a few paths for future research. First, while the plugin campus concept has indicated several promising perspectives, some of them breaking the ground of traditional engineering education, most universities do not have the required courage to get out of their comfort zones. Research is crucial to find not only knowledge and skills but dispositions that engineering teachers and decision-makers have in their tasks and visions. These studies should not remain at the level of evaluation but follow action and design science research and the combinations thereof, for a bold transformation.

Secondly, it will be important to analyze the sustainability of the plugin campus architecture for higher education. Financially, the distributed architecture would not require central, ivory tower-based physical campuses, but tiny, even mobile units that are networked with each other. If designed well, an environmentally friendly network of plugin campuses can be also ecologically sustainable. Culturally, a distributed campus can work closely aligned with any given cultural group or community, making full use of language and cultural technologies. Ethically, a plugin campus based higher education network can give a voice to people on the ground, thus improving their livelihood.

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