How can your knowledge and research from Japan create wider impacts at home? A case study of educational robotics in the Rwandan national curriculum

Study Points:

Students are expected to experience the journey of a JICA scholarship student who studied in Japan. This alumnus, who attended the Kobe Institute of Computing, successfully introduced the findings of his Masters' thesis on educational robotics to the Rwandan education ministry, with a program now being piloted in 26 schools.
Through this case discussion, students will reflect on the skills and knowledge they have developed in Japan. They will discuss the challenges, obstacles and opportunities presented in using these at home, and their skills, knowledge, and research from Japan can be incorporated into real-world scenarios upon their return.

Basic Information:

- **Region:** East Africa
- **Issue:** Utilizing knowledge and research from Japan after returning home
- **Key Words:** Research, government, education,
- **Country:** Rwanda
- **Time Period:** 2016-present

Characters:

Character	Description
Mr. Gabriel Baziramwabo (protagonist)	Former African Business Education Initiative (ABE Initiative) for Youth scholarship recipient and Rwanda Basic Education Board official, now a software instructor at the Rwanda Coding Academy
Dr. Sandor Markon	Professor at Kobe Institute of Computing

Abbreviations and Translations of Japanese Concepts

JICA	Japan International Cooperation Agency
AI	Artificial Intelligence
IoT	Internet-of-things
KIC	Kobe Institute of Computing
NGA	New Generation Academy
RCA	Rwanda Coding Academy
API	Application Programming Interface
Tankyu	Problem-based learning

Summary:
Mr. Gabriel Baziramwabo, a former ABE Initiative participant, completed his program in 2018. Since returning to Rwanda, he has become an instructor at the prestigious Rwanda Coding Academy. Since returning, his Master's thesis on educational robotics was noticed by the Rwanda Basic Education Board, and a program of educational robotics is now being piloted in 26 schools with an eye to national curriculum integration. This case explores how he was able to successfully transform his master's research into a real-world impact when he returned to Rwanda.

The chronology of events in this case study is as follows.

Chronology of Events:

2016	Start of Gabriel Baziramwabo's time at the Kobe Institute of Computing.
2018	Gabriel conducts research for his Master's thesis and successfully graduates his course.
Late 2018	Gabriel returns to Rwanda.
Early 2019	Began job at the Rwanda Coding Academy.
2021	Gabriel is invited to write an educational robotics curriculum for Kigali's New Generation Academy.
2024	Rwanda pilots educational robotics in 26 schools.

Key Questions:

Students are required to discuss the following:

1. What were the factors behind Gabriel's decision to pursue educational robotics in his Master's thesis?
2. How did the support from Dr. Markon assist Gabriel both during Japan and after his return to Rwanda?
3. What were some of the factors limiting previous attempts to introduce educational robotics to Rwanda?
4. How did the unique features of the Benax robot prototype meet his country's needs?
5. How did his research fit with the national strategy of his country?
6. What factors from Gabriel's case are applicable to your own research in Japan, and how do you think you can contribute to your country's development as he did?

Prologue:

Mr. Gabriel Baziramwabo joined the ABE Initiative in its 3rd intake in 2016. Prior to this, he had been a full-time employee of the Rwanda Basic Education Board. Gabriel had little impression of Japan before coming to the country, having applied for the scholarship through an advertisement by his coworker. He had a long-standing interest in IT, embedded systems, IoT, AI, and programming, making the Kobe Institute of Computing an ideal location in which to pursue a Master's Degree. He currently works for the Rwanda Coding Academy, and he also runs his own business.

Gabriel comes from an engineering background, and he originally studied Electronics and Telecommunications Engineering as an undergraduate. Combining his experience in the education sector and his interest in IT, he focused his efforts on robotics and core information systems, wanting to make robotics more accessible to students in his home country. KIC was an excellent environment in which to pursue this goal, and he was enthusiastic about the opportunity to pursue an ABE Initiative scholarship when the opportunity presented itself.

Gabriel's studies at KIC were supported by an excellent relationship with his supervisor, Dr. Sandor Markon, who encouraged him to develop ideas which were not only theoretical, but had practical, real-world applications. His supervisor encouraged him to develop his own ideas and helped him to think out problems. He was described as a very active, eager, and enthusiastic student, and he strongly wished, under KIC's philosophy of *tankyu* (an approach combining problem-based learning and social innovation and with a strong emphasis on real-world applications and long-term sustainability), to conduct research with practical value that could be implemented in real life situations. This led him to conduct his research on educational robotics, leading to the

formulation of a prototype named “Benax”.

Why Educational Robotics?

Educational robotics is an approach to teaching which emphasizes the use of robots to teach about various subjects, such as mathematics, physics, and, of course, programming and IT. An innovative approach to teaching, educational robotics have significant potential to contribute to education by promoting active learning, problem solving, critical thinking, and interpersonal skills (Lu et al., 2025 (Lu, Nuryana, Ni, Xu, & Nazir Alias, 2025). They also have significant potential to contribute to achieving the sustainable development goals (Lu, Nuryana, Ni, Xu, & Nazir Alias, 2025).

Gabriel himself strongly believed in the potential of educational robotics to contribute to his country’s future development, and he knew about previous attempts to introduce coding education and educational robotics into the Rwandan curriculum. These efforts, backed by researchers from MIT and using cutting-edge technology, had shown promise, but ultimately were ruled out from wide adoption due to the high costs involved in their deployment.

Nonetheless, Gabriel noted that Rwanda had already gained significant benefits from its push for IT education; he cited examples of how embedded systems had been utilized in Rwanda for various advanced applications, such as traffic control systems and blood delivery drones. His own background gave him a strong appreciation of the ability of IT to contribute to Rwanda’s national development, and early years education, IT literacy, and future-proofing the education system are core components of Rwanda’s Vision 2025 national development strategy (Republic of Rwanda, 2020).

What issues did Gabriel identify and how did he solve them?

While recognizing their potential, Gabriel identified several problems with the application of educational robotics in Rwanda as it had previously been attempted, which he wrote about in his Master’s thesis [Baziramwabo, 2018] developed at KIC under Dr. Markon’s supervision, and underpinned by the *Tankyu* philosophy of addressing real-world issues and making a social impact.

First and foremost, Gabriel identified that most programming languages and APIs are essentially English-centered, creating issues in a country in which, while English is a compulsory subject, the day-to-day language is Kinyarwanda. For example, a line of code in Python, one of the most widespread programming languages and the one which Gabriel-san had begun his project with, might look like this in a typical educational robotics API:

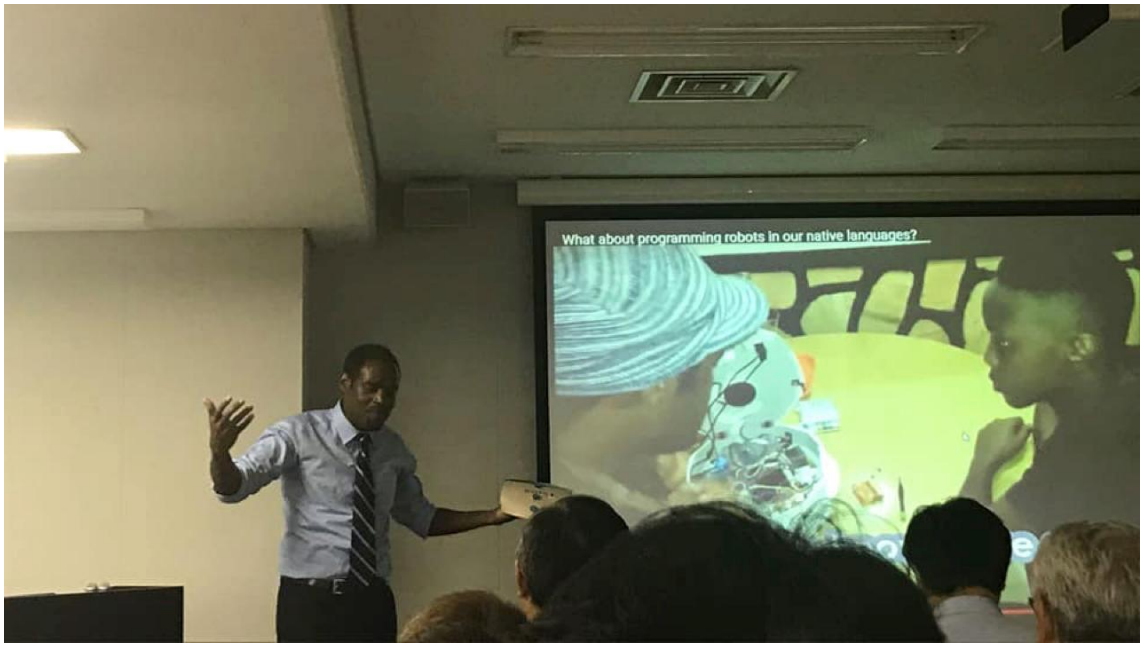
```
robot.move_forward(10)
```

This instructs a robot to move forward by ten steps. However, this requires not

only knowledge of programming syntax (the object, the function call, and the argument, and how to connect them), but also knowledge of the English words “robot”, “move” and “forward”, rather than their Kinyarwanda equivalents “roboti”, “jya” and “imbere”, which would be compiled as:

roboti.jya_imbere(10)

As most existing products and programming languages use English as their primary medium, one of Gabriel’s major contributions – and indeed one of the major milestones in his project - was creating a Kinyarwanda-focused programming language (BenaXcript) to enable the deployment of educational robotics not only in the advanced levels of the education system, but to enable deployment even from the level of early years education.



Photograph 1: Gabriel presenting his thesis at KIC. The topic of the slide focuses on the issue of programming in the Kinyarwanda language.

The second issue that Gabriel identified was the cost. Even from the beginning, Gabriel was acutely aware of the cost issue and he came to Japan with the idea to create a design that would be largely hand-made by the end-user. The design of his prototype emphasized the use of materials that could be freely or cheaply sourced, such as wood and cardboard, to limit the costs of non-core components. The core components also made use of open-source and widely available components, such as Raspberry Pi computers, to keep the costs as low as possible and to reduce fears related to breakage or loss. At the time of writing in 2025, a Raspberry Pi 4 Model B can be sourced for around $35 (US) (Raspberry Pi, 2025), and this combined with bespoke software created specifically for the prototype kept the costs low, making it well suited for Rwanda’s educational context. By comparison, an entry level product from the market leader LEGO Education, aimed at elementary school children, costs

around $330 (US) (LEGO Corporation, 2025). Moreover, the low-cost, end-user assembled nature of Benax provides children with a closer connection and a higher degree of ownership and customization than an off-the-shelf product.

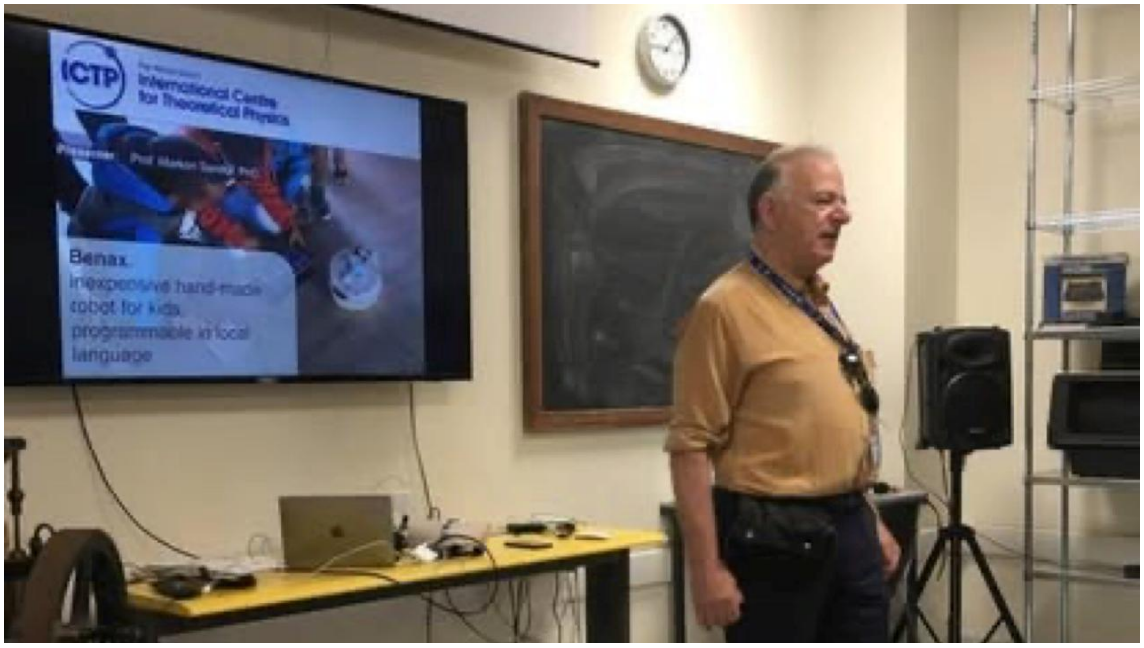
The third issue was related to accessibility. Gabriel identified an issue with existing products that they often required specific training to deploy, and were often seen as intimidating to parents who faced difficulties in learning how to use the products alongside their children. To counter this, Gabriel both made simplicity and affordability key aspects of Benax's basic design, and produced a comprehensive set of instructional materials to accompany the prototype, with the aim that parents would be able to assist their children with the construction and use of the robots at home in addition to school. This also mitigated against the need for expensive deployments of teacher training programs, which could instead focus on pedagogy and effective utilization rather than basic functionality. To assist accessibility even further, Benax can be operated via any web browser which supports JavaScript – which is to say, almost any modern web browser – ensuring almost universal compatibility without the need for specific additional devices. In some parts of rural Rwanda, internet access and electricity can also be limited, and Benax was designed to account for these limitations as well.

The fourth issue was the existing approaches to teaching. Gabriel's view was that gamifying coding education and teaching it from the earliest years of schooling would be hugely beneficial in the long-term promotion of software development skills. He held the view, influenced by approaches to mathematics and language education, that "by the time they (students) receive formal computer education, it is already too late" and that "if students become interested in a subject from a young age it is more likely to stay with them in the long term". Benax – usable by children as young as nursery school – was a direct effort to address this issue. Moreover, he strongly believed in the principle of making students passionate about the topic – in his view, real and deep passion creates more talented and motivated software engineers.

Finally, BenaXscript focuses on teaching line-by-line coding, rather than being block-based. In block-based coding, lines of code are placed in drag-and-drop "blocks" to aid ease of use, but at a cost to flexibility and fundamental understanding of programming syntax. BenaXscript forgoes this, opting instead to challenge learners to code in a manner which more closely resembles professional applications, and combining this with Benax provides a play-like environment and immediate, tangible rewards for writing authentic code.

Gabriel's thesis was thus a highly successful example of *Tankyu* in practice. Gabriel took on the challenge of solving a real-world problem – access barriers for educational robotics in his home country – and solved these issues sequentially by combining his existing expertise with his new knowledge from KIC. Indeed, Gabriel's research on Benax was of such outstanding quality that it was presented on Gabriel's behalf by Professor Markon at the prestigious

Abdus Salam International Centre for Theoretical Physics in Trieste, Italy, a world-renowned institution backed jointly by UNESCO, the Italian government, and the International Atomic Energy Agency – a moment which Professor Markon described as a major highlight in Gabriel's career.



Photograph 2: Professor Markon presenting Gabriel's work on Benax in Trieste, Italy.

Rwanda's ICT Strategy

Rwanda is a country with an ambitious development agenda. However, being a landlocked country, it is at a competitive disadvantage for traditional exports [Behuria, 2019]. All manufactured goods must pass through Tanzania, Uganda, or Kenya before reaching major oceanic shipping ports at either Mombasa or Dar Es Salaam, and air freight is only feasible for small goods, limiting Rwanda's ability to participate in global value chains [Calabrese, Papadavid, Tyson, 2017]. Rwanda even faces issues with land transport – its hilly geography means it has no railways, limiting it to only road transport [Calabrese, Papadavid, Tyson, 2017].

This is why the Rwandan government decided to make IT a core pillar of its national development strategy, including within the education system. Digital products and services need no ports, no railways, and no freight capacity. What it requires is good telecoms infrastructure and, critically, human resources who are tech-literate, comfortable with computers, and are trained in advanced applications such as programming and infrastructure management. Rwanda may not have a seaport or a railway, but what it does have is the drive and ambition to make its dream of being Africa's ICT hub a reality. It therefore comes as no surprise that the Rwanda Basic Education Board took its own interest in educational robotics.

Gabriel himself has been a part of these efforts to create a "Knowledge-Based Society" and develop Rwanda as a regional ICT hub for Africa [Ministry of Youth and ICT, 2015]. After returning from Japan, and utilizing some of the knowledge he gained there, Gabriel became an instructor at the Rwanda Coding Academy, a prestigious public special academy which formed another component of Rwanda's comprehensive ICT skills development strategy and is intended to train elite software developers.

Gabriel at the New Generation Academy

In 2021, Gabriel was approached to prepare a curriculum for the New Generation Academy, a private mixed nursery-primary school in Kigali. The school had been interested in teaching robotics, but they lacked the expertise to implement it themselves, and were referred to Gabriel by Rwanda's ICT Ministry while he was working at the RCA. Naturally, Gabriel's skills and knowledge from Japan and his expertise in educational robotics made him an ideal fit for the role.

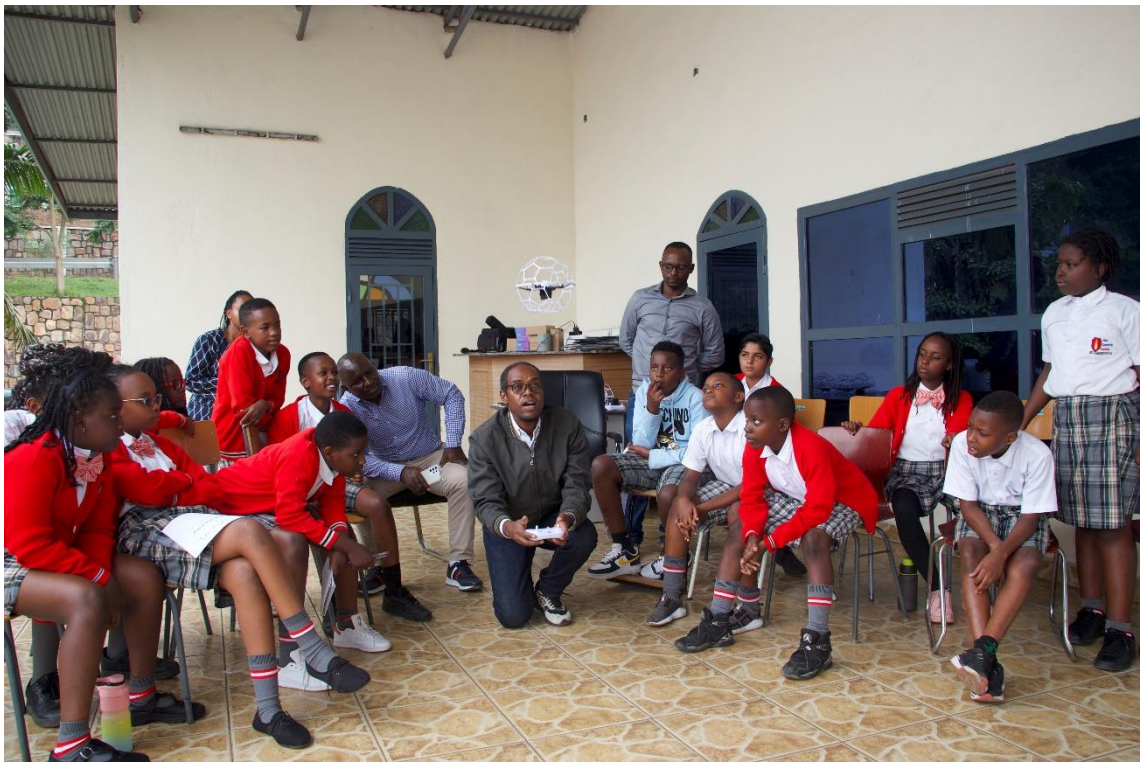
Gabriel's work at the New Generation Academy produced significant and impressive results; previously having attracted relatively few students, the deployment of advanced technology attracted significant interest, and the enrollment rate at the school skyrocketed. This, of course, generated great interest among the Education Board, who asked that Gabriel expand the curriculum design up to the lower secondary level, the equivalent of Junior High School-level in Japan, for deployment elsewhere. The school significantly boosted learning outcomes, becoming a model for others to follow, and even saw some students travel to the United States to attend a competition there (Kanamugire, 2024). In this competition, primary school-aged children were able to compete at the level of high school students (Kanamugire, 2024).

The thinking behind the curriculum was directly related to Gabriel's time at KIC, and the advice of his supervisor, Dr. Markon, who encouraged the formulation of ideas which could have long-term impact and be implemented in real scenarios, rather than only theoretical ones. Gabriel strongly believed in this philosophy, and his hard work on both the Benax prototype and the curriculum ultimately saw results in a real setting. His educational philosophy regarding coding and robotics is that "if you do it from a young age, it becomes second nature" (Kanamugire, 2024).

Gabriel's role was agreed in a memorandum of understanding (MoU) between the Rwanda Coding Academy and the New Generation Academy. This resulted in the creation of a nine-year curriculum – three for kindergarten, and six for primary education – and the creation of both teaching and learning tools. Gabriel also partially trained two teachers who were selected by the school for the program in how to use the curriculum and how to effectively teach using educational robotics, before a full-time member of staff was hired on Gabriel's

recommendation.

Gabriel spoke positively of this experience. The two teachers were highly motivated and positive, and although there was some initial hesitancy on issues like the wiring, they picked up coding relatively quickly. Some adaptations were made in light of feedback, making sure that the curriculum was compliant with concerns over issues like electrical safety and screen time for students, but by and large things progressed smoothly at the NGA, as proven by their international success. This proved transformational for the NGA, which became one of the most prestigious and sought-after schools in Kigali.



Photograph 3: Gabriel working with a class at the New Generation Academy using drones.

Piloting Educational Robotics Nationwide

Seeing the success of the New Generation Academy in implementing Gabriel's curriculum, the Rwandan government began to mull the idea of nation-wide implementation, as the country was now in a position to deploy indigenous solutions, rather than relying on overseas products and expertise as had been the case with the MIT program. Indeed, Gabriel-san himself noted the difficulty of integrating new students who have transferred between schools ~~I~~ if the curriculum is not deployed widely, and educational robotics are very much in line with Rwanda's high-tech vision and ambitious development agenda. The existence of equipment at the NGA to create new products, and the NGA's ability to act as a teacher training hub, mean that the current pilot is fundamentally much more sustainable than the previous MIT-backed efforts.

The pilot, launched by the Rwanda **Basic** Education Board and the ICT Ministry, provided 452 robotics kits to 26 schools, with some 3020 students expected to benefit across all levels of the education system, from primary to tertiary education in TVET schools, with 33 teachers having received training to use the kits effectively [Ufitiwabo, 2024]. The program received praise both at the top level, from Rwanda's ICT Minister Paula Ingabire, who noted the potential for the program to increase Rwanda's technological competitiveness (Ufitiwabo, 2024) and from the teachers implementing it, who noted that educational robotics allowed for greater practical application of theoretical concepts (Ufitiwabo, 2024).

Why was Gabriel successful?

Gabriel's interests and research in Japan synchronized very well with not only his country's development needs, but also its development *ambitions*. This high level of conceptual fit combined with the fundamental applicability and practicality of his ideas in real-world contexts were undoubtedly factors which influenced the interest in educational robotics from the Rwandan government.

Rwanda has made no secret of its ambitious ICT agenda. The government's strategy is broad and wide-ranging, and encompasses areas such as digital government service delivery via the Irembo.gov platform [United Nations Development Program, 2024], efforts to build physical infrastructure to accommodate the IT industry such as the laying of fiber-optic cables, and a human resource development strategy which foregrounds the roles of science, technology, and innovation in the country's growth plan [United Nations Technology Bank for Least Developed Countries, 2022]. Considering this ambitious push for ICT in all spheres of national life, Gabriel's equally ambitious ideas for educational robotics found a natural and enthusiastic reception, being in strong alignment with his country's development agenda.

Of course, Rwanda still faces numerous challenges, and educational robotics are a technology with the potential for high costs. These come both directly from the purchase of the equipment and indirectly through the need for teacher training in how to deploy the robots effectively in classrooms. This cost is driven up further for countries like Rwanda due to the need for localization of the interfaces into local languages, as they are typically designed foremost with English in mind. Gabriel's prototype, Benax, successfully resolved all of these issues, being considerably cheaper to produce, being straightforward to use, and being localized into and accessible in the Kinyarwanda language, which made it usable among all age groups.

Following Dr. Markon's advice, Gabriel also did not leave the idea behind in Kobe when he returned to Rwanda. Gabriel continued to iterate on it, and developed a curriculum for educational robotics at the New Generation Academy. This was inspired by the *Tankyu* approach at KIC, and a desire to conduct research with high impact potential. This continued pursuit of the idea was noticed by the ICT Ministry, which is how he was able to collaborate with the New Generation Academy and develop the curriculum there.

Steady iteration also played a role in Gabriel's success. From the initial prototype, Gabriel developed a unique expertise, which was then picked up on by the ICT Ministry and the NGA and through his job at the RCA, and this success was in turn noticed by the Education Board. Steady evidence of success at each stage was crucial; Benax and BenaXscript provided a foundation which allowed Gabriel to progress his career at the RCA, which allowed for the design of the NGA curriculum, and then finally the adoption of the curriculum into the national pilot.

What next for Gabriel and Benax?

Gabriel is continuing to develop Benax as part of his own business and is concurrently continuing his work at the Rwanda Coding Academy, where he teaches about robotics, AI, and embedded systems. In the future, he hopes to deepen his expertise even further, possibly by pursuing a PhD, and he hopes to grow his business. Gabriel has also published several academic articles on coding and AI in education. The NGA itself has become a hub for the national pilot and is involved in both the creation of materials and equipment at its laboratory as well as providing training to teachers involved in the pilot program, driving long-term sustainability and directly addressing the issues seen in the MIT program.

Educational robotics remains in its nascent stages in Rwanda, but Gabriel's experiences have shown the high potential for impact. The NGA curriculum achieved remarkable success, and now serves as a model the country is building on. In strongly aligning with both his country's national strategy and also its national ambitions, Gabriel was able to make a significant contribution, and one that may in time benefit thousands of Rwandan schoolchildren and empower the country's increasingly high-tech, forward-looking economy. The vision of Rwanda as Africa's premiere ICT hub is coming in to focus, and is shifting from ambition to reality.

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