

STEM EDUCATION SPOTLIGHT



Rwanda Quality Basic Education for Human Capital
Development (RQBEHCD)/Sub-component 1.2

Volume 1, Issue No 003



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Assoc. Prof Pheneas Nkundabakura,

Team Leader, RQBEHCD Sub-component 1.2
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Dear esteemed Readers,

In our previous *STEM Education Spotlight newsletter*, ISSUE No. 002, we shared information on the Continuous Professional Development in Innovative Teaching Mathematics and Science (CPD-ITMS) as one of the significant milestones achieved by the Rwanda Quality Basic Education for Human Capital Development RQBEHCD/ project/Sub-component 1.2, which focuses on supporting the professional development of Mathematics and Science teachers.

This STEM Education Spotlight newsletter ISSUE No. 003 is dedicated to the Bootcamp organised for Secondary school and Teacher Training College (TTC) students held at College Saint André from September 7 to 15, 2023. The Bootcamp featured hands-on activities related to projects developed and implemented by studentst.

This Bootcamp was organised under the theme *"Developing Skills and Competences in STEM through Project-Based Learning Approach."* The main objective was to foster students' critical thinking, problem-solving, teamworking skills, creativity, innovation, the culture of competition and passionately igniting interest for STEM subjects at an early age by providing a supportive learning environment and revitalizing Mathematics and Science clubs in schools through the introduction of projects.

The Bootcamp participants were students from 17 Model schools, 16 TTCs, and 30 Mathematics and Science for Sub-Saharan Africa (MS4SSA) schools. Students were trained and on experienced on various projects to be implemented at school and in their real life situation as part of the Project-Based Learning (PBL) approach, aligned with the Competence-Based Curriculum (CBC) that emphasizes on active learning to develop students' competent skills. Through PBL, students developed deep understanding and successively achieved critical thinking, collaboration, self-management, creativity, communication, and hands-on skills.

Participants expressed their appreciation for the gained experiences and pledged to become STEM ambassadors by establishing Mathematics and science clubs within their schools, developing and implementing projects to identify and solve daily challenges.

Our heartfelt gratitude goes to College Saint André for hosting the Bootcamp, the Head teachers, Districts Directors of Education (DDEs) for students nomination, and parents' cooperation. Special thanks are directed to REB and UR partnership, with acknowledgments of the DG REB and the UR-CE Principal for their unwavering support to the project. We extend our appreciation to UR-CE for providing staff to facilitate Bootcamp training.

Thank you for your continued support.



Developing Skills and Competences in STEM through Project-Based Learning approach

DG REB Dr. Nelson Mbarushimana
Official opening of the Bootcamp

The Bootcamp for secondary school students was officially opened by the Director General of the Rwanda Basic Education Board (REB), Dr. Nelson Mbarushimana. In his remarks, he emphasized the theme of the Bootcamp, “Developing Skills and Competences in STEM through Project-Based Learning approach”. He stressed that the Bootcamp would expose students to the activities that will develop and enhance their skills and competences related to the learning of Mathematics and Science subjects. He also noted that the students will develop the spirit of becoming future scientists as well as engineers in a collaborative and communicative way.

The Director General reiterated the core mission of REB which is to promote the quality of education in basic, specialized and adult schools.

“

“Education is a key to achieving sustainable economic development and we are motivated to initiate you as young people to the 21st Century skills required for your effective contribution,

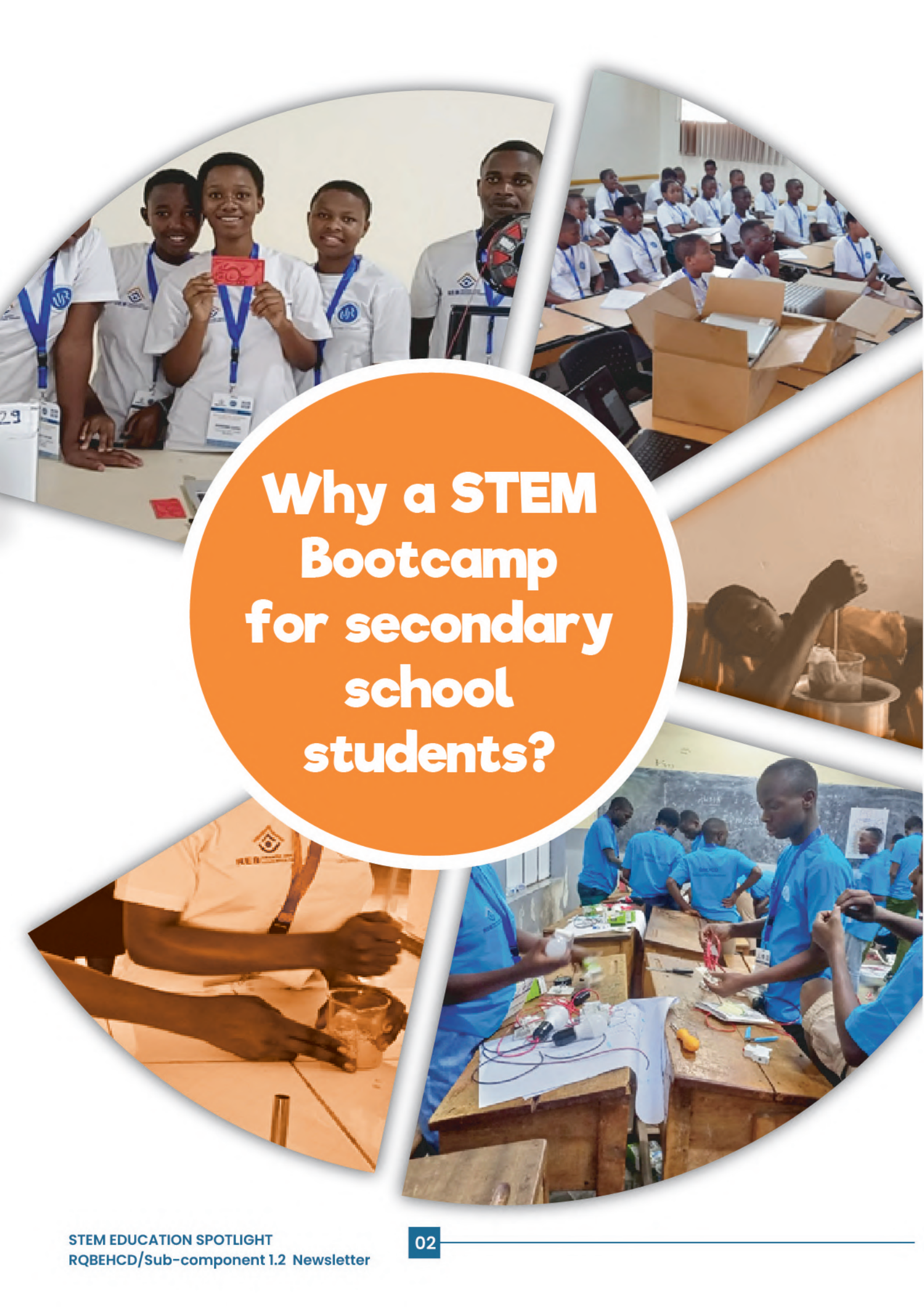
He continued by saying that one of the Rwanda Quality Basic Education for Human Capital Development RQBEHCD/, Sub-Component 1.2 project’s objective is to promote students’ learning through a Project-Based Learning (PBL) approach. He encouraged students to be committed to learning from the Bootcamp.

“You are expected to become future and competent engineers, and scientists, with high levels of critical thinking skills, collaboration, and communication skills with innovative ideas in different fields,” he said.

DG REB highlighted the four pillars that formed the basis of the Bootcamp: hands-on activities, visit to industries, “inspire-me” talks, and project competitions. He stressed their importance of hands-on activities.

“We want you to have hands-on skills, we want you to have skills and competences in STEM in order to become good future engineers, and come up with changes to develop our country,” he emphasized.

The Bootcamp opening ceremony was also attended by Nyarugenge District Executive Administrator, Mr Emmy Ngabonziza, the Coordinator of REB/SPIU, Mr Shyaka Emmanuel, the Head teacher of Collège Saint André, Father Faustin Dusabimana, among others.



Why a STEM Bootcamp for secondary school students?

Organized under the theme of “Developing Skills and Competences in STEM through Project-Based Learning”, the Bootcamp was expected to support the implementation of CBC following the recommendations of trained STEM teachers on the Project-Based Learning (PBL) approach.

The primary objective of this Bootcamp was to immerse participants in hands-on and mind-on activities to foster their skills and knowledge. It was meant to instill in students the spirit of curiosity and innovation, to respond to the pressing students’ needs, and to support teachers during Mathematics and Science club activities.

To achieve its objectives, the Bootcamp focused on four pillars namely; hands-on activities, “inspire-me” talks, visit to industries, and projects competition.

Exposing students to various hands-on activities

During the Bootcamp, students gained knowledge and skills by undertaking and building up projects related to their curriculum. They had an opportunity to learn by doing via different projects to enhance active learning pedagogy.

To bridge the gap between theoretical and practical teaching, the Bootcamp was geared towards exposing students to a variety of hands-on activities related to Physics, Chemistry, Mathematics, and Biology subjects. Through different projects, students enhanced their knowledge and skills in STEM subjects.

From the boot camp, students are able to make house electrical installation



Students making house electrical installation

In Physics, students developed and performed various hands-on activities related to solar panel, house electrical installation, and application of micro bit and sensors projects.

Concerning solar panel, they assembled different components of solar lantern system and used it to build simple electric circuit. They also placed solar panel in a way that helps to store much solar energy. Next, they installed a house prototype and connected electric wires to lamps and to sockets. Participants could measure electrical continuity with a multimeter. They further dealt with micro bit and sensors assembling different components of a smart home kit and coding programs to run numerous sensors for a given project.

With beeswax, students made different products



Students busy making soap in Chemistry laboratory

In Chemistry group, students conducted “beeswax-based products” and “Saponification” projects.

Students processed raw beeswax, which many people consider as waste products, and came up with body cream, candles, and shoe polish.

Regarding saponification, students used various resources to make different types of soaps such as solid soaps and liquid soaps. In addition, they made medical soaps, and detergents during the competition.



Students busy with beeswax processing in chemistry laboratory

A 3D printing of a “Plant Cell Model”

With Fusion 360 as a cloud-based 3D modeling and CAD software, students created complex and realistic 3D models of various objects. They used these tools to design, modify, optimize their 3D models, and prepared them for printing.



Figure: The facilitator giving an introduction to Fusion 360 and Ultimaker Cura.

Students to assemble and programme robots for specific tasks

With the advancement of science and technology, robots are widely used in different domains including education especially in programming. In this regard, students in Mathematics group were introduced to programming virtual robotics. They learnt to interact with the VEXcode-VR interface, setting the background in which VR can interact and move.

The educational robotics included as well Physical robotics. The students assembled the robots, programmed them with ROBOTC software, controlled them with joystick, and gave them instructions to interact with the environment to perform specific tasks. Students were challenged to write down a ROBOTC program that instructs their robot holding an empty plastic bottle to move autonomously on a prepared ramp. The robot should deposit the plastic bottle at the upper end of the ramp and then come back to its starting point.



Hands-on enhancement during assembling a robot.

From milk to cheese and yoghurt

Students developed a sand-charcoal filter and used it to clean dirty dump water. They got enough clean water that can be used for cooking and other household activities such as cleaning and washing.

In food processing, students baked cake from wheat flour. They also produced yogurt and cheese from milk. The organized hands-on activities on water cleaning and food processing had an overall purpose of applying the concepts and principles the students learn in biology classes to solve real life problems.

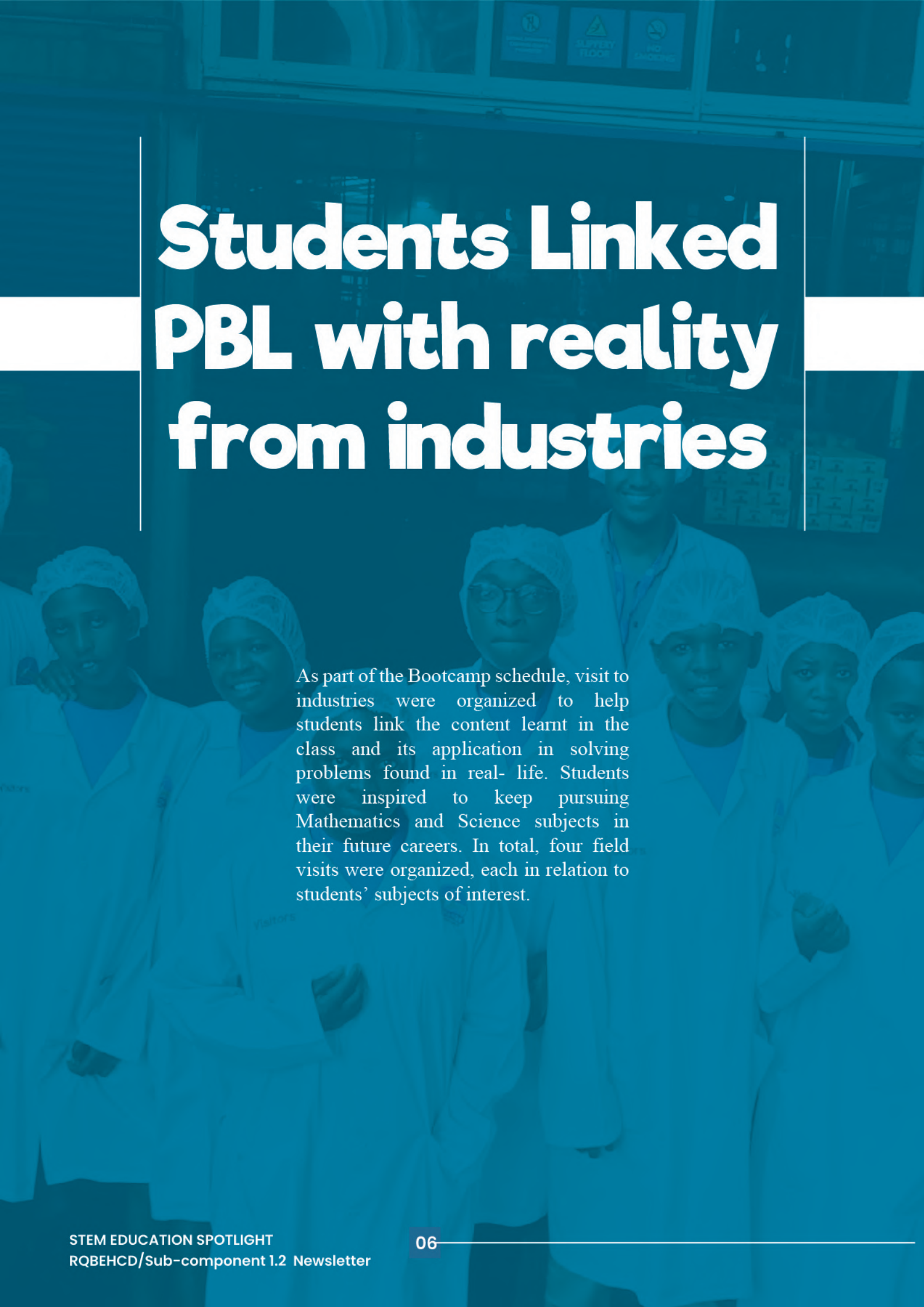


3D printing of a "Plant Cell Model".



Students formed groups and started discussing on their projects





Students Linked PBL with reality from industries

As part of the Bootcamp schedule, visit to industries were organized to help students link the content learnt in the class and its application in solving problems found in real- life. Students were inspired to keep pursuing Mathematics and Science subjects in their future careers. In total, four field visits were organized, each in relation to students' subjects of interest.

Visit to Great Lakes Energies (Physics group)

Great Lakes Energy is a company that is specialized in solar energy systems. The company is headquartered in Kigali, Rwanda and primarily serves the East African market.



Students observing solar panel installation

During this visit, students from physics group visited a solar energy installation at Hope Haven Christian Secondary School, located in Ndera Sector, Gasabo District. The students eye-witnessed that solar energy is an alternative source of electrical energy.

Visit to Inyange Industries Ltd (Biology Group)

Inyange industries is a company engaged in the business of producing and selling a wide variety of fruit products, dairy related products and mineral water in Rwanda.



Inyange Industries Ltd staff and students group photo

Biology group conducted a field visit at Inyange Industries Ltd. The visit aimed at allowing students to relate what they already learned to what takes place in industry especially regarding food processing and water purification and packaging procedures.

Visit to Sulfo Rwanda Industries Ltd (Chemistry Group)

Sulfo Rwanda is manufacturing Industry that specialized in Soaps, Packaged Drinking Water, Cosmetic, Cosmetics, Plastics and Detergent in Rwanda.

Students were excited by how Chemistry is useful in making different products.



Students and their facilitator in a group pose photo at Sulfo Rwanda Industries Ltd

Visit to Fablab and Creativity Lab (Mathematics Group)

FabLab Rwanda is the fabrication laboratory in Rwanda. It offers space for members to turn innovative ideas into products especially in the hardware and electronics domain.

The Mathematics and Robotics groups visited a Fablab located at Kacyiru. Students explored 3D model design and printing and were excited to see improvised labs, hands-on lab equipment, etc.

Students further benefited from the demonstrations done by Creativity Lab. Creativity Lab works with schools to support teachers incorporate STEM in teaching and conduct after school STEM workshops for students in Programming, Engineering, Robotics and Artificial Intelligence (AI).



Students at Fablab



“Inspire-me” talks



During the Bootcamp, students were inspired through talks by scientists from diverse institutions on the following topics:

- 21st Century skills and STEM careers
- Gender and STEM education
- Role models in STEM education
- To embrace coding as a future career
- Who is a good STEM student?

The students inspired on 21st Century skills and STEM careers



Dr. Christine Niyizamwiyitira addressing student on century skills and STEM careers

In her talk, Dr. Christine Niyizamwiyitira has an intensive experience in teaching and researcher. She took the participants through the 21st Century skills. *“As a young generation, you must be good collaborators, communicators, and problem solvers. This will help you to be where you want to be,”* Niyizamwiyitira challenged the students.

She highlighted the importance of studying STEM-related subjects and urged the students to link their future careers to the 4th Industrial Revolution which is based on technology. *“...so, care about your education career path by not missing the right things that prepare you for where you want to be and what you want to have,”* she advised the students.

Both boys and girls have full potential to learn STEM subjects



Dr. Batamuriza Jeniffer addressing students (to be replaced by another with more audience)

Dr. Jennifer Batamuliza is a lecturer in Technology and head of Data Driven Incubation Hub and Short Professional Courses at the African Center of Excellence in Data Science at the University of Rwanda. In her talk, she urged both female and male students to unlock their potential by exploring the vast world of Science, Technology, Engineering, and Mathematics. She encouraged them to make efforts in their studies for success in life. *“Both boys and girls have full potential, and opportunities needed to thrive in the future,”* she argued. *“The question is how you use these opportunities you have as STEM students to shape your future the way you want it. I want you to make positive change for yourself, your country and the world at large. Set your long-term goals, work hard to achieve them, be resilient, well-disciplined, and persistent. Think big, act and turn challenges into opportunities,”* she urged the students.

“Your dedication and hard work in STEM will lead to a brighter and more promising future”

-Dr. Didacienne Mukanyirigira



Dr. Didacienne Mukanyirigira addressing the students

In her interaction with the students, Dr. Didacienne Mukanyirigira said, *“By choosing STEM subjects, you will not only acquire knowledge but also you will become the architects of innovation and progress.”* She added that their dedication and hard work in STEM will lead them to a brighter and more promising future, where they can make a positive impact on the society and the world as a whole. Relating her personal career development path, she said: *“It is all about determination, practice, and resilience that I became capable of realizing my dreams to become an electrical mechanical engineer in telecommunication.”*

In the same vein, Dr. Diane Sengati, the Ag. Head of Department of ICT in Education/REB, introduced the students to the importance of ICT, putting much emphasis on communication. She further advised them to take initiative and develop the necessary skills to discover solutions through STEM subjects.



Diane Sengati, the Head of Department in the ICT in Education Department at REB

Dr. Abijuru Delphine is the Chairperson of the Rwanda Chapter of the Organization for Women in Science for the Developing World (OWSD) and is Head of Science and Technology in the Research and Development at Rwanda Energy Group (REG). In her talk,



Dr. Abijuru Delphine is the Chairperson of the Rwanda Chapter of the Organization for Women in Science for the Developing World (OWSD)

Dr. Abijuru Delphine mentioned that students should have faith in their abilities and confidence to excel. She encouraged them to nurture their innate curiosity and embrace persistence and perseverance in their STEM pursuits.

Students exhibiting ingenuity in Mathematics and Science

With regard to different products of their projects, towards the end of the Bootcamp, students demonstrated ingenuity to contribute to solving societal problems. They developed projects for competition in alignment with Mathematics and Science subjects.

In Mathematics, students used 3D Printing knowledge and skills to design and produce some laboratory teaching and learning materials, including test tubes holders and funnels, pyramids, mortar and pestle, and plant cell model. They also assembled and programmed a robot.



Ramp challenge with physical robot

Among Physics related projects, students developed and presented a home prototype with auto-plant watering, water leakage detector and water reuse, a smart fan, automated fire extinguisher/fire short fighters, auto-sliding windows, and auto-opening door projects.

A home prototype with auto-plant watering project emerged first not only at physics subject level but also the Bootcamp level.



An auto-plant watering project

In Chemistry, the developed and presented projects during the competition included making multipurpose glue from Styrofoam, aloe-vera based medical soap, honey-based medical soap, detergent, and egg shell toothpaste.

The best project at Chemistry subject level, at the same time the second at the Bootcamp level, was *"Making multipurpose glue from Styrofoam"*.

In Biology, the five competing projects were: Making briquettes, faster production of organic fertilizers from household wastes, making the teaching and learning aids from waste papers, and production of cooking oil from avocados. From this competition, *"Fast production of organic fertilizer"* was the best.



Students presenting the best project to invitees

"Home prototype with auto-plant watering, water leakage detector and water reuse" of the Physics group, was the best project at the Bootcamp level. A group of six members was awarded a Lenovo laptop for each.



The awarding of the best project group at the Bootcamp level

Students who participated in the Bootcamp are committed to becoming innovators.

Considering students' reflections on the package gained from the Bootcamp, one can admit that the Bootcamp has been a stepping stone for them towards innovation for societal problem solving. In view of the achievements made with hands-on activities, "inspire-me" talks, visit to industries, and projects competition, students revealed that the PBL will be successfully implemented in secondary schools.



Students making a candle in Chemistry laboratory



*Christella Imbaragazimana from
GS Notre Dame de Lourdes Byimana*

Students appreciated what they learnt from all the conducted activities. Christella Imbaragazimana, a Senior 2 student from GS Notre Dame de Lourdes Byimana, expresses her feelings saying, "I am very happy to have learnt how to make beeswax-based products such as body lotion, candles, and shoe polish."

Closing ceremony

In the closing ceremony, the invitees toured different stands from which students presented their projects. Among them were the World Bank-Rwanda representatives, REB officials, and the Head teacher of Collège Saint André that hosted the Bootcamp. While interacting with students, the invitees appreciated how they were explaining their projects and answering questions with confidence.

After touring students' projects, the World Bank Representative, Dr. Tihtina Zenebe Gebre, Senior Economist and Task Team Leader for RQBEHCD Project, appreciated what the Government of Rwanda is doing in education sector especially the implementation of the Sub-Component 1.2 of RQBEHCD Project.

Dr. Tihtina does believe that a comprehensive intervention of RQBEHCD Sub-Component 1.2 that considers bringing students learning together is significantly aligned with the objectives of the project. She asked them to grab the opportunity offered and to take it as a lighting candle for their future education as scientists and engineers to become. Dr. Tihtina encouraged them to disseminate what they have learnt during the Bootcamp to their fellow students and keep applying them in their daily life.

In his remarks, the REB-SPIU Coordinator Shyaka Emmanuel, stressed that the Government of Rwanda believes in the role of STEM in supporting Rwanda to achieve vision 2050, which is in the education development aspect of quality education, science, technology, and innovation. He continued by saying that the Government of Rwanda through Ministry of Education (MINEDUC) and REB will continue to do what it takes to achieve the desired outcomes of quality education through supporting STEM.

He encouraged all stakeholders and development partners in education sector to work together and support science and technology to improve our lives. *"There is a need for all stakeholders to keep supporting STEM education,"* adding, *"all these talents of students which were shown here in the projects of students must be supported."*

He called on the students to be the light of others and the community at large. *"During this Bootcamp, with the support of your facilitators, you demonstrated what you are able to. Please, be the vessel of the knowledge to other students, be the light of the community you are part of, keep practising what you have learned here in order to discover more,"* he underlined.

The REB-SPIU Coordinator appreciated the industries which inspired the students to shape the career and solve the societal problems, and wished other industries would play their role in shaping young people bright future through exposing them to more learning opportunities. *"Visiting industries was very crucial even to us as one of the main pillars of the Bootcamp. I don't doubt that it inspired you to think big and become competent engineers, scientists, doctors, and be able to solve societal problems,"* he affirmed.

In his concluding remarks, Shyaka thanked everyone who made the Bootcamp a success, notably, Nyarugenge District management, the host Collège St. André, UR-CE, and REB teams, and guest speakers.



Meet the facilitators of the Bootcamp

The Bootcamp was a success thanks to facilitators for their active collaboration and commitment to help students demonstrate their potential in Mathematics and Science through hands-on activities and various projects.

1. Physics Team

Mrs. Nyirahabimana Pascasie (Team leader)
Mr. Musengimana Theophile
Mr. Dusabumuremyi Victor
Dr. Nzabahimana Joseph
Mr. Bugingo Jean Bosco
Dr. Minani Evariste

2. Biology Team

Mrs. Mukamwambari Concilie (Team Leader)
Dr. Habiyaemye Jean de Dieu
Mr. Shumbusho Flugence
Mrs. Mukagihana Josiane
Dr. Rutegwa Marcellin

3. Robotics Mathematics Team

Dr. Habimana Olivier (Team Leader)
Mr. Uwambajimana Sylvere
Dr. Ntalindwa Theoneste
Mr. Gasana Jean Claude
Mr. Umukozi Augustin
Mr. Gapfizi Peter

4. 3D-Mathematics Team

Mr. Dushimimana Jean Claude (Team Leader)
Mrs. Uwurukundo Marie Sagesse
Mr. Iyamuremye Emmanuel
Dr. Maniraho Jean François
Prof. Mutarutinya Vedaste
Mrs. Dorimana Aline

5. Chemistry Team

Dr. Utetiwabo Wellars (Team leader)
Prof. Niyonzima Niyongabo François
Dr. Mujiyambere Jean Marie Vianney
Dr. Nkurunziza Jean Baptiste
Mrs. Musengimana Jeannette
Mr. Nkundumukiza Joseph
Mr. Niyonsenga Adrien
Dr. Gakuba Emmanuel
Mrs. Ntihabose Ruth
Dr. Karegeya Claude

6. Coordination team

Prof. Nkundabakura Pheneas
Mr. Ndikubwayo Leodgard
Dr. Nsengimana Theophile
Mrs. Uwamariya Eugenie

7. Communication

Mr. Ntirandekura Schadrac

Ministry of Education
and Sports

REB
RWANDA BASIC
EDUCATION BOARD

YUJUN BOHRA

Collège St. André, UR-CE and REB staff with invited officials at the opening of the Bootcamp



PICTORIAL

