

Rwanda Quality Basic Education for Human Capital Development (RQBEHCD) Sub-component 1.2: Support Professional Development of Teachers in Mathematics and Science.



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Foreword

Dear Readers,

We are honoured to present to you ISSUE No 001 of the Newsletter produced by the World Bank-funded Rwanda Quality Basic Education for Human Capital Development (RQBEHCD) project in its Sub-component 1.2 related to supporting the professional development of Maths and Science teachers.

One of the project's objectives is to enhance teacher effectiveness for improved student learning through support for the Professional Development of Mathematics and Science teachers from upper primary to lower secondary (P4-S3). The University of Rwanda-College of Education (UR-CE) is partnering with the Rwanda Basic Education Board (REB) in the project implementation.

The project implementation kicked off back in 2020 with the development of modernized tools and it continued with training of Mathematics and Science teachers/tutors from 16 TTCs, 16 model schools and 30 Mathematics and Science for Sub-Saharan Africa (MS4SSA) pilot schools in Innovative Teaching Methods for Maths and Science.

In its endeavour, the project's activities emphasize the learner-centred method in the framework of the Rwanda Competence-Based Curriculum (CBC). Also in the quest to modernize teaching and learning Mathematics and Learning, the Sub-component has introduced Project-Based Learning (PBL).

The objective of this Newsletter is therefore to inform the public and education stakeholders about the sub-component's achieved milestones.

Issue N° 001 captures information about the milestones achieved so far in the PBL approach.



Associate Professor Pheneas Nkundabakura,
UR-CE Academic Staff, Team Leader, RQBEHCD
project/Sub-component 1.2

This Newsletter will be produced quarterly. ISSUE N° 001 focuses on the training of Mathematics and Science teachers/tutors from 16 TTCs, 16 model schools, and 30 MS4SSA pilot schools trained in the first cohort on PBL approach.

1. Rwanda Quality Basic Education for Human Capital Development (RQBEHCD) Sub-component 1.2: Support Professional Development of Teachers in Mathematics and Science.

PROJECT OVERVIEW

The Government of Rwanda, through the Ministry of Education (MINEDUC) and the Rwanda Basic Education Board (REB), is implementing the Rwanda Quality Basic Education for Human Capital Development (RQBEHCD) project. One of the project's objective is to enhance teacher effectiveness for improved student learning through the support of professional development of Mathematics and Science teachers.

The RQBEHCD Sub-component 1.2 seeks to modernize instructional tools and enhance the knowledge and pedagogical skills of Mathematics and Science teachers in upper primary and lower secondary grades (P4-S3).

The project developed scripted lessons for all lessons in Mathematics and Science curricula from P4 to S3. Such lessons are aligned with the Rwandan Competence-Based Curriculum (CBC) framework and are prepared using open-source digital resources. These lessons aim to support teachers with insufficient backgrounds in Mathematics and Science, reduce the burden of lesson preparation, and improve the quality of content presented to students.

The project initiative emphasizes four channels:

- a) Increasing teachers' content knowledge,*
- b) Improving classroom teaching practices,*
- c) Ensuring the availability of critical teaching materials and ICT tools in the classroom, and*
- d) Providing continuous support to teachers in their teaching profession.*

To modernize instructional tools for effective teaching and learning Mathematics and Science, three innovations have been made. These are Scripted Lessons, Virtual Science Laboratories (VSLs), and Project-Based Learning (PBL) approach.

The present Issue N^o: 001 focuses on PBL.

PBL is a teaching method in which students learn by actively engaging in real-world and personally meaningful projects. In PBL, students work on projects over an extended period from a week up to a trimester or beyond. These projects engage students in solving a real-world problem or answering a complex question.

Students demonstrate their knowledge and skills by creating a public product or presentation for a real audience. As a result, students develop deep content knowledge as well as critical thinking, collaboration, creativity, and communication skills. All these skills are emphasised in the CBC.

UR-CE staff, in collaboration with REB, developed PBL modules and/or projects. These modules/projects were inspired by the Mathematics and Science for Sub-Saharan Africa (MS4SSA) project, which was initiated by the World Bank Group in collaboration with Worcester Polytechnic Institute (WPI).

These projects were reviewed and aligned with the Rwanda CBC. RQBEHCD/Sub-component 1.2 has taken an initiative to launch this Newsletter to inform education stakeholders on the milestones that are being achieved through the implementation of the project with a view to improving the teaching and learning of Mathematics and Science.



Sensitization workshop of school leader about PBL approach.

2. WHY PBL IN THE CONTEXT OF RWANDAN COMPETENCE-BASED CURRICULUM?

PBL helps students to identify problems in their daily lives and solve them with developed critical thinking and problem-solving skills



Teachers/Tutors training on PBL approach

PBL, as one of the learner-centered teaching approaches was proposed by RQBEHCD project team leaders to be a sustainable solution that could address the identified problem in the teaching and learning of Mathematics and Science.

PBL has been chosen to promote CBC competences including problem-solving, lifelong learning, research, creativity and innovation, critical thinking, collaboration, communication, among others

Development of PBL Modules / Projects for Mathematics and Science Teachers / Tutors' Training..

Under RQBEHCD project/Sub-component 1.2 support, UR-CE developed 15 modules/projects linked to Mathematics, Biology, Physics, and Chemistry. The developed modules are:

1. Introduction to PBL
2. Water Cleaning,
3. Saponification
4. School Kitchen Garden
5. Beeswax-based Products (body lotion, shoes polish, and candles)
6. Food Processing
7. Introduction to Robotics
8. Introduction to Virtual Robotics
9. Robotics Applications
10. Introduction to 3D Objects
11. Introduction to 3D Printing
12. 3D Printing Application and Projects
13. Solar Energy and Solar Lantern
14. House Electrical Installation Project, and
15. Micro Bit-projects

These modules were reviewed by external reviewers and validated by REB from 29th July to 07th August 2022 in a workshop held at the University of Rwanda-College of Agriculture and Veterinary Medicine (UR-CAVM).

3. Teachers/Tutors Training on PBL Approach



This training gathered one hundred twenty-two (122) Mathematics and Science teachers/tutors for the first cohort from 20th to 30th September, 2022 at GS Cyahafi, Nyarugenge District, Kigali City. They were trained on 15 modules/projects.

Trainees had the opportunities to conduct hands-on activities/projects related to their respective subjects.

3.a. School Kitchen Garden Project



Planting of vegetables in the school kitchen garden

From 1st to 2nd October 2022 at GS Cyahafi training center, Biology and Chemistry teachers/tutors' group were trained to set up a kitchen garden in the school compound.

Participants discussed how to integrate kitchen garden project in their teaching practices to facilitate the learning of types of food nutrients, benefits of a balanced diet, use of fertilizers in kitchen gardens, importance of having kitchen gardens in households, and appropriate techniques in agro-veto projects.

Teachers gained a deep understanding on the role of the school garden kitchen in supporting school feeding program.

Charles Luanga Karegeya, a teacher at GS Zaza A, Ngoma District, Eastern Province, said, "School kitchen garden is important because it enables teachers to effectively teach plant related concepts with reference to vegetables grown in the school kitchen garden. In addition, growing different types of vegetables helps learners understand how to prevent malnutrition."



Charles Luanga Karegeya,
Teacher at GS Zaza A

3.b. Food Processing projects



In addition to school kitchen garden, Biology and Chemistry teachers/tutors were trained on food processing and simple protocols and their applications to process cheese, yogurt, and cake. Cheese and yogurt production, as well as cake baking are among food products that are industrially produced at a large scale for commercial purposes.

In the context of CBC implementation, making cheese, cake and yogurt emphasizes learning by doing and hands-on pedagogy whereby learners are exposed to various practical activities. This learning approach does not only concretize the Science theories and principles, but also connects the learning theories to the real-life environment in which students live.



Marie Claire Ingabire, a Chemistry teacher at GSNDL Byimana, Ruhango District, Southern Province said that food processing project is more exciting as it enhances the implementation of CBC which requires practicals, It will help my students improve their skills and relate concepts of measurements, heat, temperature, mixture, etc to their daily lives". "The project will help to address nutritional and economic issues". She added.



Marie Claire Ingabire,
Chemistry teacher at GSNDL Byimana



"Students who are more knowledgeable about water cleaning procedures and who apply these procedures at home and school can undoubtedly contribute to solving the issues related to contaminated water," noted Celestin Singaya, a Chemistry teacher at GS Saint Etienne Shyogwe, Muhanga District, Southern Province.



Celestin Singaya,
Chemistry teacher at GS St Etienne Shyogwe.

3.c. Water Cleaning Project

This project on water cleaning is in line with the Chemistry content taught in S2, Unit 3: Water pollution. It is also in line with other connected units of Chemistry and Biology Curricula at the Ordinary level.

Training on water cleaning enabled participants to understand the process of water filtration, water boiling, and how to construct a sand-charcoalbased water filtration system. They were also trained on how to test physicochemical properties of water quality by focusing on changes in the temperature, pH, and chloride ions. Participants also gained knowledge and skills to perform a biological test of water quality focusing on the presence of parasites such as Amoeba.



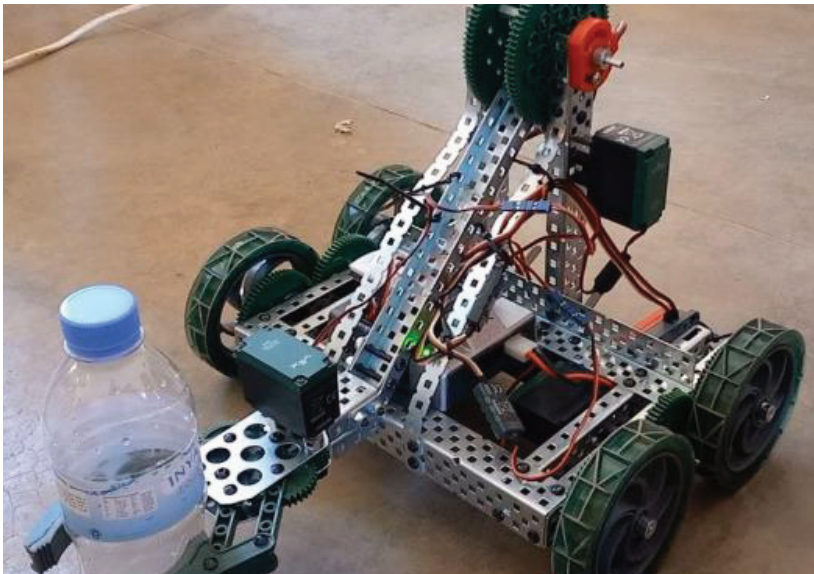
The main goal of the CBC is to equip students with the knowledge, skills, attitudes, and values which are aligned with the necessary 21st century requirements. "As far as teaching and learning Mathematics and Science is concerned, effective use of PBL approach will enhance the implementation of CBC. CBC emphasizes on developing students' competences linking classroom practices to everyday life experiences which make science fun and responding to the societal needs and skills needed at the global labor market."



Dr. Theophile Nsengimana,
UR-CE Academic Staff, the RQBEHCD Project
Deputy Team Leader

3.d. Robotics Applications Training for Mathematics and Physics Teachers/Tutors

PBL projects will assist STEM teachers in implementing the CBC and promoting experimental based learning



A robot is a programmable machine that imitates the actions or appearance of an intelligent creature, usually a human being. Robots can be used in agriculture, spraying insecticides, harvesting, photography, in security and so on.

From 1st to 2nd October 2022 at GS Cyahafi training center, Mathematics and Physics teachers/tutors have been trained on robotics. They were introduced to basics concepts, assembling, and disassembling a robot, programming a VEX Robot, maintenance, and safety of educational robots.

The use of robotics in the implementation of a competence-based curriculum has been given attention. Teachers gained insight into the installation of the code editor for programming a VEX Robot (weight lifting robot), set up motors and sensors of a VEX Robot, write, and compile the code for VEX Robot's basic features using ROBOTC, deploy the program to the controller/brain of VEX Robot.

RQBEHCD project/ Sub-component 1.2 provided VEX Robots to 62 schools.



“

This training on the assembling of robots has improved my planning skills, programming skills, innovation, monitoring students' projects. These skills will enable me to teach more effectively the concepts of motions, displacement, speed, velocity, and some mathematical concepts like linear function, gradient,... which were difficult to me to explain,” commented Alice Iradukunda.



Alice Iradukunda,
Mathematics tutor at TTC
SAVE, Gisagara District

3.e. 3D Printing Training for Mathematics and Physics Teachers/Tutors



Face mask and cup printed by 3D printer

From 1st to 2nd October 2022 at GS Cyahafi training center, Mathematics and Physics teachers/tutors were trained on how 3D printer works and how to differentiate 2D from 3D objects. These teachers were trained on different types of 3D printers, the relevance of 3D printing in teaching Mathematics, the effective use of 3D printers, the contribution of 3D printers in Mathematics PBL, assembling the 3D printer (Ender 3), and keeping proper maintenance of a 3D printer.

During this training, trainees learned how to design a 3D object using Computer Assisted Design (CAD) software, specifically Fusion 360 software. This CAD is used to design any object before printing for Mathematics and Physics teaching purposes.

3D printing (three-dimensional printing) is the making of 3D objects by layering twodimensional cross sections sequentially, one on top of another. In education sector, 3D printing is a revolutionary and innovative technology that brings with itself, new methods of teaching and learning concepts

that were very difficult to teach with the traditional methods. 3D printing skills help teachers/tutors to effectively teach the concept of locating objects in 3D space, designing different 3D shapes and so on. These skills are also advantageous since they give practical exposure related to the Fourth Industrial Revolution.



Ildephonse Habineza, a teacher at ES Rutobwe, Kamonyi District, noted that He was happy to get the opportunity to assemble robotics and teach students how to do it as well. "Since 3D Printing is applied in education, it will help me teach my students more effectively about some difficult concepts such as geometrical objects, shapes presentation, to name a few," he highlighted. "I believe that with the use of 3D printing and hands-on activities my students will get more excited and engaged," he added.



Ildephonse Habineza,
Teacher at ES Rutobwe,

3.f. Solar Energy and Solar Lantern & House Electrical Installation Project



Solar Energy and Solar Lantern Project

The growing energy need, and the increasing environmental concerns are global challenges that require all of us to find alternative sources of energy that can replace the non-renewables sources of energy and polluting fossil fuel. It is against this backdrop that RQBEHCD project has identified Solar Energy and Solar Lantern project as one of the components to be developed and trained on for Mathematics and Science Teachers/ Tutors.



Pascasie Nyirahabimana, a Physics Lecturer from the University of Rwanda -College of Education, and a facilitator in Project-Based Learning (PBL) approach, stressed that “Solar Energy and Solar Lantern projects aim at helping secondary school STEM teachers to clearly understand and demonstrate different concepts related to solar energy, energy transformation and energy consumption embedded in the S1, S2 and S3 CBC Physics syllabus used in Rwanda.” Further, through these projects, awareness on energy consumed is enhanced.

Through these projects, students, will be helped to connect the gained knowledge and skills with their real-life in solving energy related problems in their families, she added.



Pascasie Nyirahabimana,
Physics Lecturer UR-CE and a facilitator in PBL.



House Electrical Installation

House Electrical Installation Project

The training on House Electrical Installation aims to help participants to put into action or practice different physics theories related to electricity.

These trainings evolve around how electrical installation in houses is done, importance of house electrical installation skills, required materials, and electrical safety usability of lean contents.

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“This training facilitates Physics and Mathematics teachers/tutors to find solutions to simple home-based issues which are related to electrical installation in their homes. In Rwandan CBC we find different concepts related to electricity and its uses in real life. Especially in S3 the whole unit 10 is called House electric installation where some teachers were struggling with how to teach this unit. There are other concepts related to electricity such as unit 15 in S3 calle basic electronics and electronic devices etc”, Theophile Musengimana said.



Theophile Musengimana

Physics Lecturer UR-CE and a facilitator in PBL.

4. TEACHERS /TUTORS PERCEPTIONS TOWARD PBL APPROACH

Trained Teachers/tutors are optimistic that PBL approach will enhance teaching Mathematics and Science.

They also believe that PBL will boost students' curiosity for making scientific discoveries and increase their interest and confidence in Mathematics and Science. Gained skills through PBL will make students competitive in the global labor market.

Consolee Nyiramahoro, a Biology teacher at GS Saint Philip Neri Gisagara, Southern Province, noted “During this PBL training I realized a very important thing. These PBL projects were designed to improve teaching Mathematics and Science. They can also help address challenges that we face in real-life. For example, regarding the issue of uncleaned water, we have learnt an easy way to clean it using local materials like charcoal, sand, cotton and so on.” She added that effective implementation of this projects will help learners to get more creative and open-minded to find solutions in their every-day life.



Consolee Nyiramahoro,

Biology teacher at
GS St Philip Neri Gisagara



Jean de Dieu Uwitonze,
Physics teacher at GS Umubano II

“

These projects will help our students to discover and become more confident in learning Mathematics and Science. They will develop in students the spirit of entrepreneurship” said Jean de Dieu Uwitonze, a Teacher at GS Umubano II, Rubavu District, Western Province.

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Julienne Niyotwizera, a teacher at ES Saint Jean de Murunda, Rutsiro District, said that Kitchen Garden project will help teachers to teach concepts in Biology curriculum such as food nutrients and diet, flowering plants, and photosynthesis. “The school garden will be used as a didactic material. Students will get the advantage of learning components of a balanced diet to fight malnutrition,” she added.



Julienne Niyotwizera,
Teacher at ES Saint Jean de Murunda

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Emmy Niyomugenga,
Teacher, GS Matimba.

“We appreciated these projects so much. I believe that our students will be more engaged as they will like these hands-on activities we have been performing,” said Emmy Niyomugenga, teacher, GS Matimba.

He continued saying “The only problem we are going to face is limited time because our teaching timetable is usually full. So, it will not be easy for us to get enough time to conduct these projects. But we believe that with the assistance of our school leaders we shall come up with a solution.”

5. Evaluation of Rwanda Quality Basic Education for Human Capital Development Project Sub-component 1.2 Implementation Progress by the World Bank Consultant Dr. Jee Peng Tan.



Students were excited to implement Project-Based Learning (PBL) approach

The World Bank Consultant, Dr. Jee Peng Tan visited Rwanda from 11th to 24th January 2023 to evaluate the implementation progress of the World

Bank-funded project (Rwanda Quality Basic Education for the Human Capital Development project, subcomponent 1.2). Subcomponent 1.2 seeks to modernize instructional tools and enhance the teachers' content knowledge and pedagogical practice of Mathematics and Science teachers from upper primary through lower secondary (P4-S3).

Dr. Jee Peng accompanied by a team of staff from the University of Rwanda-College of Education (UR-CE) and the Rwanda Basic Education Board (REB) in charge of sub-component 1.2 implementation activities conducted field visits in schools. Those schools include FAWE Girls School Gahini, Kayanza District, Eastern Province; GS Gitarama and GS Kabgayi B, Muhanga District,

as well as GSNDL Byimana, Ruhango District in the Southern Province.

PBL projects allow students to learn by doing. It is in this regards students are excited to design, develop and implement various projects with the help of their trained teachers.

A senior three student at FAWE Girls School Gahini commented on their water cleaning project, "We have noticed that there are people in our villages who are experiencing the challenges of getting clean water". "Therefore, my classmates and I decided to start this water cleaning project in our village to solve the issues by using locally accessible materials like cotton, charcoal, and sand to provide clean water and we expect to end up sharing these skills with our neighbours."

Another student praised the VEX robot project, "We learned how to program the robot, and then we did many practices. Robots can be used to assist or free up human labour from certain tasks. For instance, this one is mobile in all directions. We can direct it to move and deliver any item we desire, such as a bottle of water."

The visiting team observed PBL projects at GS Gitarama, including house electrical installation, solar panel and lantern project-connected materials, and 3D printing project products, among others. A jerrycan of liquid soap made by the students is one of the amazing project's products.

GS NDL Byimana was also visited. Students explained confidently their projects to the visiting team. They highlighted the importance of PBL projects that allowed them to learn Science by doing more practices. "We completed this saponification project as senior six MCB students with the assistance of our Chemistry teacher. Our project's main goal is to make more soap for both our school and the community. We intend to make it an income-generating project."



GS NDL Byimana, a senior two-student group representative

As they moved to the next project stand, a senior two-student group representative told the visitors, "We have a project of Food Processing. As you see here, these are very tasteful cakes we have made ourselves. We are planning to improve this project because people like cakes. We can generate money. It will even help us after our studies. With this project, we cannot be jobless."

In general, it is evident that, following students' perceptions on PBL projects, progress is being made in CBC implementation, and there is hope this trend will continue as PBL projects encourage students to learn through doing. School leaders are encouraged to support teachers/tutors in integrating PBL projects successfully into classroom activities.

6. RQBEHCD Sub-component 1.2 Gallery



Thank You