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Collaborative Learning Ecosystems (CLEs) across selected African universities

A Baseline Mapping of Learning activities in the AgrGROW Partner Institutions

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1. Introduction

Background:

AgrGROW is partnership between agro-based higher education institutions (HEIs) in Malawi (MW), Uganda (UG), Denmark (DK), Finland (FIN) and the Regional Universities Forum for Capacity Building in Agriculture (RUFORUM) for transformation of agropreneurhship education. The lack of entrepreneurial mind-set hinders graduates' employability, and prevents their capacity to employ, and become entrepreneurs. This is a challenge in the Sub-Saharan African (SSA) bioeconomy sector especially in the agriculture-based economies of Malawi and Uganda where agrivalue chains in the circular economy, offers job opportunities.

The key objectives of the AgrGROW project include enhancing a) improved student-centred teaching and learning methods by introducing problem-based learning, climate-smart agriculture, and innovative entrepreneurship training; and b) promoting actively cooperating network-based learning ecosystem with academia and societal/industry partners in the East and South African context. The University-industry collaboration (UIC) helps to combine material, intellectual or other resources to enhance development of students' capacity to solve real-life problems, through fostering innovations, new products development, technology and skilled graduates (Siegel, 2010; Ankrah & AL-Tabbaa, 2015).

1.1.1 General Objective

The mapping exercise was aimed at identifying and quantifying Collaborative Learning Ecosystem (CLE) activities in general (all types of learning activities) across African universities namely; Bugema University (BU) (co-lead), Makerere University (MAK), and Malawi University of Science and Technology (MUST), in Malawi.

1.1.2 Purpose

The study focused on mapping the different types and the extent of learning activities that take place across the university-society boundary within the context of the CLE. This is necessary to provide an understanding of what and how much is already happening within the CLEs and to identify barriers and facilitating factors hindering or promoting the use and development of CLEs.

1.1.3 Research Questions

The CLE mapping exercise was guided by three major questions (Hjortsø, 2023), but not all questions were answered by each of the partner universities. The questions included the following:

i. Which types of learning activities that involve external actors is the university engaged in (learning can have students, staff, and/or external actors as the main learners)?

ii. To what extent do these activities take place (how often, how many students are exposed to these activities)?

iii. What is the role of the external actors involved in the learning activities (as learners or providers of learning opportunities or beneficiaries in some other way)?

2 Study Methodology

2.1.1 Study background and Context

The baseline survey was conducted in six departments across three universities in the Eastern and Southern Africa. The participating departments in the survey included; Department of Agriculture and Environmental Sciences (DAES), at BU; Department of Environmental Management (DEM) at MAK; Department of Engineering, under Malawi institute of Technology (MIT) at MUST; Department of clinical sciences, under the Academy of Medical Sciences (AMS), (MUST), Department of Earth sciences, under the Ndata School of Climate and Earth Sciences (NSCES),(MUST), and the Department of Language and communication, under the Bingu School of Culture and Heritage (BISCH) (MUST). The University of Copenhagen (UCPH), in Denmark, together with HAMK, in Finland, provided technical guidance and the framework for conducting the mapping exercise.

The collected data was based on conversations with colleagues and interviews with staff members. Also, an online tool was developed at MUST, with structured questions to gather data from lecturers regarding their teaching practices, engagement with pedagogical activities, and perspectives on innovative teaching methods such as Problem-Based Learning (PBL). Across the universities, the unit of analysis was each of those identified learning activities that involve any

linkage with an external partner. The collected data was summarised in Excel datasets and analysed by descriptive statistics.

2.1.2 Defining Collaborative Learning Ecosystem (CLE)

Under the AgrGROW project, the CLE has been operationally defined as the learning activities that take place across the boundary between the university and its surrounding social environment and involve external actor(s). This 'actor' can be a public or private organization or individual, for-profit or not-for-profit, operating as formal or informal. Learners can be students, staff, or external actors. The ecosystem is also shaped by the social norms, rules, and other institutions that regulate the system. Finally, the system consists of physical structures and tools that are used in the learning process, or that frame the process, for example, computer programs or office space. The learning is collaborative because it happens in collaboration between the external partner and the teacher and learner, i.e., some sort of action is taken by the external partner, for example, in the form of a challenge given by the host organization, a presentation of a problem the student will work on, access for the student to physical resources used in the learning process (e.g., a field or a machine), or giving students feedback on a solution.

2.1.3 Bugema University CLE – Department of Agricultural and Environmental Sciences (DAES)

The School of Agriculture and Applied Sciences (SAAS) is a new school (started in 2021) and curved out of the School of Natural Sciences, where programs in Agriculture and Environmental sciences were originally offered under the Department of Life and Physical Sciences. The SAAS also hosts the Department of Nutrition, Food Science and Technology, formerly under the School of Health Sciences. With this reorganization and alignment, Bugema University has very high expectations from the two departments at the SAAS. This is especially the case because the two departments are addressing education capacity building as well as research and outreach in the domain of key aspects of Uganda's economic pillar – namely, Agriculture.

Currently, a range of degree, diploma, and certificate programs are offered at DAES, including: the Bachelor of Science in Agriculture (with majors in Crop Sciences, Animal Sciences, Biotechnology, Soil Sciences); Bachelor of Science, Environmental Sciences; Bachelor of Science in Agribusiness Innovations and Management; Diploma in Agriculture – with majors in Crop Sciences or Animal Sciences); and Certificate in General Agriculture.

2.1.4 Makerere University CLE – Department of Environmental Management (DEM)

The Department of Environmental Management (DEM), under the College of Agricultural and Environmental Sciences (CAES) was established in 1988 in response to increasing concerns by the government of Uganda and Makerere University about the rampant Environmental degradation in Uganda, with a mandate to promote the development of knowledge, skills, and positive attitudes for sustainable management of the environmental resources and natural resources through training and research. The department started with a two-year master's programme in Environment and Natural Resources, and this has been supplemented by an active PhD programme and post-graduate Diploma in Environmental and Social Impact Assessment. Due to persistent appeals from Makerere University and the public, an undergraduate programme; Bachelor of Environmental Science was also established, in 2003. Department of Environmental Management has over the years been committed to improving the quality of its graduates through continuously diversifying teaching methods. In this regard, the DEM has a strategic direction to actively seek partnerships with industry to enhance the students' experiential teaching and learning experiences. The industry-university partnerships have been demonstrated through input during the curriculum review process and seldom played any significant role in the teaching and learning process.

2.1.5 Malawi University of Science and Technology (MUST) CLE

The Malawi University of Science and Technology (MUST) is Malawi's leading public university, established by an Act of Parliament in 2012, and officially opened in 2014. The university was established to fill the gaps in higher education and human resource development. Its primary aim is to promote the development, adaptation, transfer, and application of science, technology, and innovation for the macro- and microeconomic development of Malawi. Its vision is to be a world-class centre of science and technology, innovation, and entrepreneurship, with a mission of providing a cutting edge, relevant and umunthu-centric pedagogical experience in higher education, research, and innovation, responsive to societal needs.

2.1.6 Mapping of Teaching Activities

The purpose of WP4 Problem based Learning - Collaborative Learning Ecosystem (CLE) Creation and Testing is to understand:

i. How university CLEs function to engage in delivering quality teaching and learning
ii. Which barriers and promoting factors influence the performance of the CLEs

iii. How the CLEs can be further developed
iv. How the CLEs can be used to implement student challenge-based courses (online and face-to-face) within the AgrGROW project context and scope.

The mapping of teaching activities i.e. WP4-T4.1.1 is required to enhance building, creating, testing, and strengthening the CLEs in the HEIs. The result of this initial exercise is a dataset of pedagogical activities with a brief report on the nature of the academic unit mapped. This forms a basis for the identification of suitable PBL cases for further investigations i.e T4.1.2. Therefore, the AgrGROW partners are expected to develop, test and refine their industry/business partnerships for the benefit of the graduates

3 Study Findings

3.1.1 Learning Activities in the Bugema University CLE

Nine collaborative learning activities were identified at the BU CLE, and the most frequent activity was special projects. The CLE had four types of external actors, i.e. government research centres (GRCs), private business companies (PBC), non-government organisations (NGOs) and the local community farmers (LFs). The government actors facilitated the highest percentage (77.7%) of collaborative learning activities (CLAs). These include industrial training, practicals, field trips, case studies, and commodity value chain. The PBCs facilitated six CLAs (66.7%) including learn as you earn (LAYE), guest lectures, industrial training, field trips, commodity value chain, and special projects. The local farmers support two CLAs (22.2%), such as; group/cohort learning and special projects, while NGOs participated in three CLAs (33.3%), namely; guest lectures, field trips, and case studies (Table 1).

Table 1. Bugema University CLE activities and external actors involved

CLE activities	Frequency in academic year 2022/2023	Type of actors involved
Industrial training/internships	1	NGOs, GRCs, PBC
Commodity value chain (CVC)	2	GRCs, LFs, PBC
Learn as You Earn (LAYE)	1	LFs, PBC
Guest Lectures (GL)	1	PBC, GRCs
Cohort Learning/Group learning	2	LFs,
Case Studies	2	GRCs
Field Trips	1	GRCs, PBC
Practicals (soil/biotech, others)	2	GRCs, PBC
Special projects	4	GRCs, LFs, PBC

Actors: GRCs- Government research Institutes; PBC-private public business companies; LFs- Local farmers; LCs-local communities; NGOs-non government organisations

3.1.2 Characteristics of Learning Activities (LAs) in the BU CLE

As a new department, DAES is working under low resource capacity for teaching, learning, research and outreach. The biggest challenge is the lack of learning infrastructure like well-resourced laboratories. However, DAES remains sensitive to the fact that agriculture and related disciplines are best delivered through hands-on approaches. Therefore, DAES relies on collaboration and partnerships with the community and research institutions for practical aspects that are strategically weaved into the different CLA including the following:

1) Special Projects: this course unit is done every semester by Agriculture students. The course exposes students to hands-on experiences in different areas of specialisations such as crop science or animal sciences. The teacher guides students in undertaking practical activities through demonstrations, experiments and field practicals. This CLA provides an opportunity for students to practice different skills, while making use of their creativity and innovation skills in agriculture.
2) Research Projects: This is also conducted as a course unit, by students in their final academic year through selecting research topics of their choice and develop a research proposal in consultation with assigned research supervisors. The research supervisor can be internal within DAES or external depending on the selected topic. The student takes a lead role in execution of research activities, such as; data collection, analysis, and report writing. The assigned supervisor facilitates the student in further steps and processes of research leading

to report, validation of data and final presentation/defence of research findings, and submission of the research dissertation for assessment. This activity is done once in the student's academic lifetime.

3) Firm Case Studies: this CLA is undertaken by agribusiness students as part of the course assignment in farm management and operations. The students identify a firm enterprise, they visit the enterprise to study daily operations in management, and also find opportunities to assess the profitability of certain projects using farm records, in consultations with the key firm actors.

4) Field Practical Excursions: this activity is implemented within specific segments of the available course units. The teacher identifies a particular learning area which require field practical activities to be performed, and makes deliberate arrangements with the government or private research centres to take students for the practicals. The procedures and protocol of the practical are provided by the external actors identified. Also, the actors provide learning infrastructure, materials and the real demonstrations of the practical skills before students. Usually, the students have limited opportunity to practice similar practical skills within the facilities of the external actors, due to time constraints, but they largely observe demonstrations to acquire the skills.

5) Industrial Attachments/Internships: this course provides an opportunity for students to gain relevant work experience in different areas of interest in agriculture. The students train for 8 weeks in an agricultural environment which could be an educational institution, research center, government ministry, local government agency, or private commercial agricultural company. During this period, the students are expected to make a significant contribution to a relevant project under the supervision of industrial staff and Bugema University personnel. Additionally, students are obliged to participate in all relevant Industrial training programs so as to gain additional skills in different areas of option, such as; Biotechnology and Plant breeding; Agronomy and soil fertility, Animal Production and Nutrition, Crop Science, and Agribusiness Innovation and Management. At the end of the training, the students prepare a final report on their placement, and make a presentation of their work. Agriculture students attend two internship sessions before graduation, and only one Internship session for students specializing in Agribusiness Innovation and Management (BU-Bulletin, 2020-2024).

6) Real Life Project: This learning activity, involves engagement of students into the implementation of a real-life project. Although not very commonly used, it is sometimes considered to provide students with some hand-on experiences and skills.

All the learning activities presented are amenable to either problem-based or project-based instruction and learning. The instructors follow a minimum guideline presented in the Academic Bulletin, but they are free to innovate and facilitate the students towards deeper learning.

Over 80% of the learning activities identified in the BU CLE are implemented once a year, and 16% twice a year. However, most learning activities (>90%) are within the formal curricula, and they benefit mainly students, and few activities benefit both students and teachers. Eighty per cent of external actors in the BU CLE were involved in providing learning aids, infrastructure and technical skills. Only 20% were involved in co-creation of knowledge with BU and providing strategic markets for students' products under the Learn as You Earn (LAYE) teaching and learning approach. More than 90% of the CLAs are focused at enabling students to gain practical or hands-on skills in different areas of the taught courses. Such activities include; special projects, group/cohort learning, case studies, and industrial training or internships. Ten percent of the activities were focused on developing soft skills, business innovation skills, and entrepreneurial competencies.

3.1.3 Level of Teachers' involvement in the BU CLE learning activities

The DAES has twenty-five teachers with over 100 students enrolled in its four-year bachelor's education. Ten teachers (36%) were involved in the CLAs, while the extent of teachers' involvement in the BU CLAs varied from one learning activity to another.

A higher percentage of the courses in the BU CLE exhibited well-structured skills and competences achievable through cohort/group learning (95.1%), industrial training (83.6%), and case studies (60.7%). However, fewer courses exhibited skills and contents achievable through learn as you earn (56.6%), guest lectures (11.5%), field trips (37.7%), practicals (36.9%), special projects (49.2%), and commodity value chain (36.9%). Most students (>70%) were exposed to guest lectures, special projects, cohort/group learning, and Industrial training while <30% of students got exposed to other CLAs (CVC, LAYE, CST, FTs, PRTs) (Table 2).

Table 1 Teachers' involvement in Collaborative Learning Activities (CLAs) for 2022/2023 academic year

Type of CLE learning activity	No. of teachers involved	No. of courses linked to CLAs	% of courses connected to the CLAs	No. of students exposed to the LAs (Ns=100)
Industrial training/internships	10	102	83.6%	75
Commodity value chain (CVC)	1	45	36.9%	25
Learn as You Earn (LAYE)	1	69	56.6%	25
Guest Lectures	1	14	11.5%	100
Cohort Learning/Group learning	2	116	95.1%	100
Case Studies (CST)	2	74	60.7%	25
Field Trips (FTs)	8	46	37.7%	25
Practicals (soil/biotech, (PRT)	3	45	36.9%	25
Special projects	8	60	49.2%	100

Number of courses mapped (N_C = 122); Total Number of Teachers at DAES (N_T = 25) N_S= number of students (Ns=100; Animal sc=25, Crop science =50, Agribusiness=25)

3.1.4 Frequency of collaborative learning activities for 2022/2023 Academic year

The students' exposure to CLAs in the BU CLE increased from year 1 to year 3, but declined in the final educational years. All students were exposed to guest lectures, special projects and cohort/group learning. (Table 3). Most CLAs were exposed to students once in the whole academic year while others other CLAs exposed to students twice in the 2022/2023 academic year. Commodity value chain (CVC), industrial attachment and case studies were implemented once to 2nd and 3rd year students, unlike practicals, special projects, field trips, cohort/group learning, guest lectures that were exposed to all students across the 3 to 4 academic years.

Table 2 Frequency of students' exposure to CLE activities in Academic year 2022/2023

Academic year (s)	Year 1	Year 2	Year 3	Year 4	Students exposed
Learning Activities					
Industrial training/internships	-	1	1	-	All (2nd - 3rd)
Commodity value chain	-	1	1	-	AIM, CS, AS
Learn as You Earn (LAYE)	1	1	1	-	(1st -3rd)
Guest Lectures	1	1	1	1	All
Cohort Learning/Group learning	2	2	2	2	All
Case Studies	-	1	1	-	All (AIM)
Field Trips	1	1	2	1	All (CS, AS)
Practicals (soil/biotech, others)	1	1	1	1	CS, AS
Special projects	2	2	2	2	All

Number of courses mapped (N_C = 122) Number of Teachers (N_T = 25) CS = Crop science, AS = Animal Science, AIM = Agribusiness innovations and Management programs.

3.1.5 Industry partners' involvement in the BU CLE

The BU CLE is characterised by four types of external partners: government research institutes, private business companies, non-government organisations (NGOs), and local farmers. Major industry actors are government research institutes such as Namulonge Crop Research Resources Institute (NaCRRI), National Livestock Resources Research Institute Nakyesasa (NaLIRI), National Forestry Authority (NFA), Namalere Agricultural Referral Mechanisation Center, National Animal Genetic Resources center and Data Bank (NAGRC&DB) and Makerere University Agricultural Research Institute Kabanyolo (MUARIK). The private companies include; Agrotech Analytical Services, Ugachick Limited, Kakira Sugar works (KSW), Kawumu Tannery Factory (KTF), Sugar Corporation of Uganda Limited, (SCOUL), Grain Pulse Limited Mukono (GPL), Xclusive Kalanchoe Uganda Limited (XKLU). Tilda Uganda (TDLU), Global vet Uganda (GVL), Farmers challenge Bunsule-crop farm (BFCC), and farmers challenge Bunsule-Animal farm (BCAF). One NGO, the Consortium for Enhancing University responsiveness to Agribusiness (CURAD) was identified.

The industrial partner in the CLEs serve two major purposes:

- to provide resources that facilitate learning and co-creation of knowledge within the BU CLE, such as; learning aids; lab equipment; reagents; infrastructure; labspace; practical specimens; protocols; new technology; and the market for students' products; and
- directly participating in enhancing learning through co-supervision of the learning; training; demonstrations; complimenting and blending theoretical expositions with practical real-life scenarios; and exposing students to the world of work through strategic integration of students' activities into the routine operation within the organisation.

3.1.6 Interactions and Networks in the BU CLE

The interactions between learning activities have been illustrated to show points of coordination within the CLE, with emphasis to the relationship between the CLE's core functions (research, teaching, innovation and community engagement), the learning activities in curriculum, key available resources, and external actors who support the CLE's core functions. Some of the BU CLE's resources include laboratories, animal farm, demonstration farm, and the memorandum of understanding with the government research centres (GRCs) such as NaCRRI. The special projects are designed to facilitate capacity for innovations and research skills among students, enhanced by laboratories, demonstration sites and the dairy farms. Similarly, community engagement is also

facilitated by CLAs such as cohort/group learning, industrial attachment and commodity value chain or learn as you earn (Figure 1). The five collaborative learning activities considered for further investigations as part of the qualitative dimension of the CLE baseline study include: Group – Cohort Learning (CILA); Special project (CS and AS); Field practicals; Industrial training/Internship; Learn-as-you-earn (LAYE)

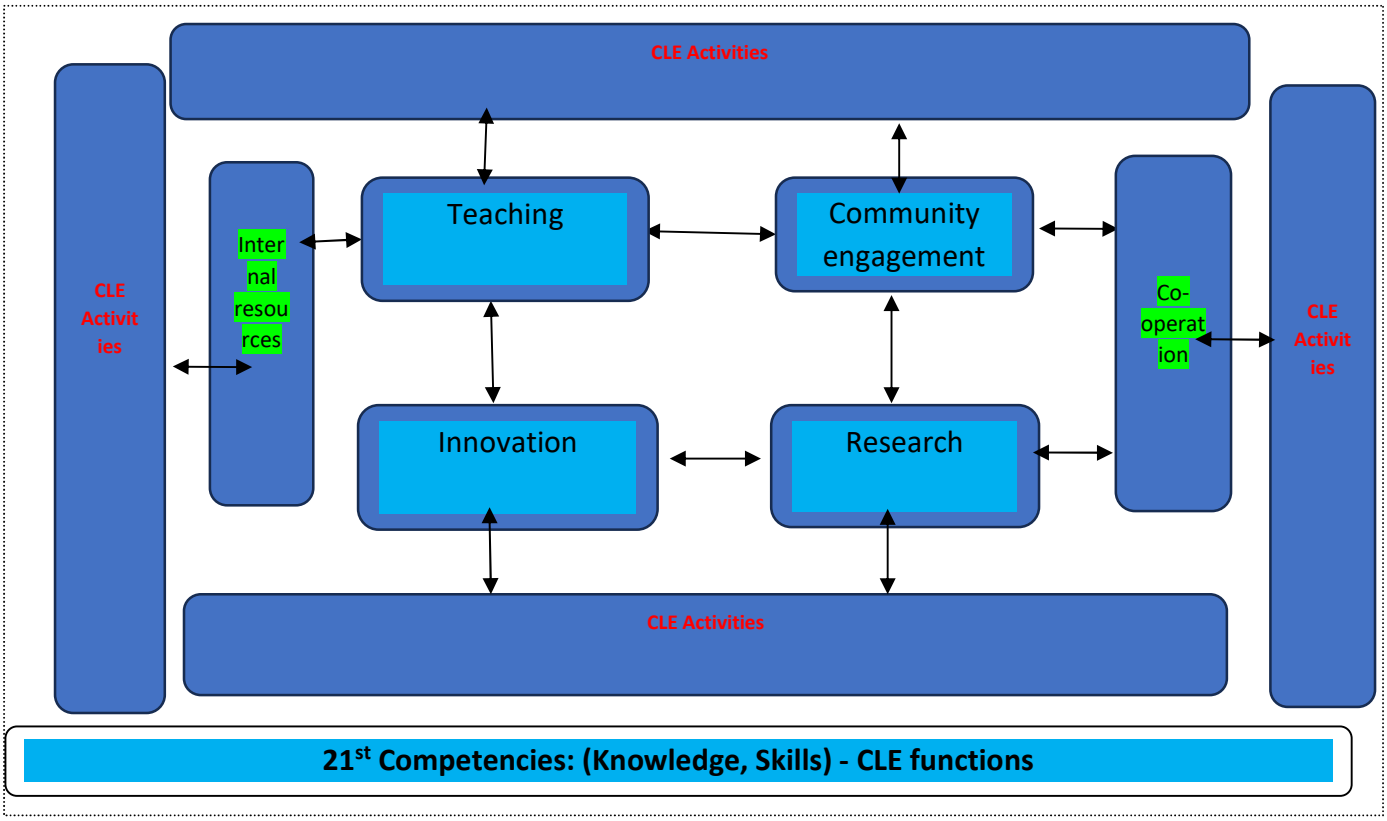

Figure 2. Illustration of the CLE Network at DAES, Bugema University

3.1.7 Learning Activities in the MAK-DEM CLE

There were four categories of learning activities implemented with industry partners with the most common activity being Internship. The CLE at DEM-MAK has five types of external actors, including government Ministries, Departments and Agencies (MDAs), private business companies

(PBC), non-government organizations (NGOs), Local governments and Training and Research Institutions (TRIs). The CLAs include internship, research supervision, guest lecturing and examination. (Table 3.1).

Table 4 CLE activities and external actors involved at DEM-MAK

CLE Activities	Type of actors involved
Industrial training/internships	NGOs, MDAs, PBC, TRIs, GRCs, LGs
Guest Lectures (GL)	TRIs, MDAs, GRCs
Co-supervision of Special projects/dissertations	TRIs, MDAs, GRCs
Examination	TRIs, GRCs
Field Trips	NGOs, MDAs, PBC, TRIs

Actors GRCs- Government research Institutes; PBC-private public business companies; NGOs-non government organisations; MDAs-Ministries, Departments and Agencies; TRIs-Training and Research Institutions, LGs-Local Governments

3.1.8 Characteristics of Learning Activities (LAs) used in the MAK - DEM CLE

DEM has established links with various institutions and individuals within and outside the region, with special interests in the environment and natural resource management that could provide technical assistance in running academic programmes. These include; the International Union for Conservation of Nature (IUCN), USAID-REDSO, University of Dar es Salaam, Institute of Impact Assessment-UK, UNEP, NEMA, ARDHI University (formerly the University College of Lands and Architectural Studies) Dar es Salaam, Uganda Association for Impact Assessment (UAIA) and the East African Association for Impact Assessment (EAAIA).

For off-campus practical engagements, the Makerere University Biological Field Station (MUBFS) Kibale capable of handling 200 research students and staff and Nyabyeya field station are available to DEM and appropriate for field exposure and practical skilling in courses including ecology, biodiversity conservation, rural land use, and community conservation. The facilities can also host students who can access neighboring developmental projects for courses such as ESIA, waste management and Pollution assessment. They are both in proximity to the various sites of Oil and Gas development, and industrial developments such as Sugarcane industries.

The CLE activities are described below:

1. Special Projects: Special Projects/dissertations is a compulsory course unit for all

students at DEM. This course enhances students' ability across key themes that aim to respond to a wide range of global challenges through Proposal development, data collection, analysis and interpretation and scientific communication. The course covers practical aspects of a research journey and orientates the students to real-life experiences in the field. This helps the student put into practice the theory learnt in lectures. During their research journey, students get the opportunity to interact with other researchers outside the university.

2. Guest Lectures: These are complementary teaching and learning activities where students get the opportunity to interact and hear from practitioners in the industry. The lectures are usually moderated by a member of staff and the Guest speaker gives a one-hour talk on a specific theme that applies to a particular course unit. Thereafter students have the opportunity for a Q&A session where they get more knowledge.
3. Industrial Attachments and Internships: In this course, a student is assigned to an organization for a period of 6 weeks to gain hands-on experience in environmental management tasks, get an overall appreciation of the Environment and Natural Resource sector and enhance the student's learning experience. While on field Attachment, the students are guided by supervisors from different Departments in and outside the University. This is a field-based course and activities are designed by the field supervisors from the districts and institutions/organisations where the student is attached.

3.1.9 Level of Teachers' involvement in the DEM-MAK CLE learning activities

All staff members in DEM have undergone specialised training in areas of environment and natural resources management to teach, supervise and carry out research in different fields of environmental management. Because of the multi and interdisciplinary nature of the Environmental Science training, the Department collaborates with other members of staff within the College of Agricultural and Environmental Sciences and other Colleges of Makerere University.

Table 5 Teachers' involvement in Collaborative Learning Activities (CLAs) for 2021/2022 academic year

Type of CLE learning activity	No. of teachers involved	No. of courses linked to	*% of courses connected to the LAs*	No. of students exposed to the LAs (Ns=90
Industrial training/internships	12	57	100%	76
Guest Lectures (GL	2	2	3.5%	90
Co-supervision of Special projects/dissertations	8	-	-	-
Examination	-	-	-	-[1]
Field Trips	8	6	10.5%	90

Number of courses mapped (NC = 57); Total Number of Teachers at DEM (NT = 16) NS= number of students (Ns=90; BEVS=76, PGDEIA =14)

3.1.1 Frequency of collaborative learning activities for 2022/2023 Academic year

The students' exposure to CLAs in the DEM-MAK CLE intensified as the learners progress from year one to year three, due the compulsory nature of special projects/dissertation. All students benefitted from the CLAs apart from Industrial training which is not on the curriculum for the Post graduate diploma in Environment and Social Impact assessment program. The learning activities are scheduled throughout the programs.

[1] Examination with external partners is restricted for post-graduate research projects/thesis

Table 6 Frequency of students' exposure to CLE activities in Academic year 2021/2022

Academic year (s)	Year 1	Year 2	Year 3	Students exposed
Industrial training/internships	-	1		All
Guest Lectures (GL	-	1	1	Depends on Course unit
Co-supervision of Special projects/dissertations	-	-	1	All
Examination	-	-	-	-
Field Trips	2	2	2	All

3.1.2 Industry partners' involvement in CLE

The DEM-MAK CLE is characterised by different industry partners: government research institutes, private business companies, non-government organisations (NGOs), and MDAs. Major industry actors aregovernment research institutes such as the National Agricultural Research Organization. The private business companies in the DEM-MAK CLE include; DeWaste Uganda Limited, Kakira Sugar Works (KSW), Sugar Corporation of Uganda Limited, (SCOUL), Local governments include, Kampala Capital City Authority, Hoima District Local Government, Mukono District Local Government. Wakiso District Local Government. MDAs include the Ministry of Water and Environment, National Environment Management Authority, National Water and Sewerage Corporation etc.

The external partner involvement in the CLEs serves two major purposes:

- to provide resources that facilitate learning and co-creation of knowledge, inform of learning aids; lab equipment; reagents; infrastructure; lab space; practical specimens; protocols; new technology; and
- directly participating in enhancing learning through co-supervision of the learning; training; making demonstrations; complimenting and blending theoretical expositions with practical

real- life scenarios; and exposing students to the world of work through strategic integration of students' activities into the routine operation within the organization.

4 Pedagogical Activities in the MUST CLE

Lectures, were the predominant method of teaching, indicating a strong preference for traditional instructional approaches. Group discussions (30) and hands-on activities (24) are also widely utilized, highlighting an emphasis on interactive and practical learning experiences. Field trips (20), case studies (23), and problem-based learning (25) reflect significant engagement with real-world applications and critical thinking exercises. In contrast, the flipped classroom approach (3) was the least utilized method, suggesting an area for potential development in adopting modern pedagogical strategies. Moderate usage of collaborative projects (9), peer teaching (9), online discussions (9), laboratory experiments (19), and internships (9) indicates a balanced integration of collaborative and experiential learning opportunities. The data showcases a diverse range of teaching methods at MUST, emphasizing traditional lectures and interactive activities while identifying opportunities for enhancing innovative teaching practices.

4.1.1 Curriculum Integration

Majority (74%) of the MUST CLAs were integrated into the curriculum. This indicates a focus on ensuring that innovative and effective teaching methods are embedded within the standard educational framework. In contrast, 21% of the learning activities are conducted outside of the curriculum, highlighting the importance of extracurricular engagement in the educational experience, though to a lesser extent. Additionally, there are 2 activities classified as "other," suggesting some variability in how these pedagogical methods are applied or categorized. This data suggests that the majority of pedagogical activities are designed to complement and enhance the core academic curriculum, thereby supporting a structured and comprehensive educational experience for students at MUST. The relatively fewer activities conducted outside the curriculum reflect additional opportunities for learning that extend beyond traditional classroom settings, promoting a well-rounded educational approach.

4.1.2 Beneficiaries in the Learning Activities

Most activities were directed towards students, with 43 responses identifying them as the primary learners. This suggests that the main focus of teaching efforts at MUST is on the student body, aligning with the university's mission to provide quality education and facilitate student learning. Faculty and staff also participated significantly in these pedagogical activities, with 12 responses indicating their involvement. This highlights the university's commitment to continuous professional development and collaborative learning among its educators and administrative personnel. There are 9 responses for external participants as primary learner, showcasing the university's efforts to engage with the wider community and industry partners. This engagement is crucial for practical learning experiences, offering real-world context and applications to the theoretical knowledge gained in the classroom.

The data also reflects a well-rounded approach to pedagogical activities at MUST, with a strong emphasis on student learning while also promoting the professional growth of faculty and staff and fostering community and industry partnerships. This diverse engagement supports a comprehensive learning ecosystem that benefits all stakeholders involved.

4.1.3 Frequency of Activities

The pedagogical activities at MUST, such as lectures and laboratory practicals, predominantly occur every semester (38 responses). This structured approach ensures consistent integration of teaching and learning experiences throughout the academic year. Additionally, 2 responses suggested activities happening every other semester, possibly related to work-integrated learning, while 2 responses indicate less frequent occurrences, highlighting a potential need for scheduling adjustments. Overall, maintaining a balanced and regular schedule of pedagogical activities is crucial in fostering effective teaching and learning outcomes.

4.1.4 Involvement of External Actors

With 14 responses emphasizing their provision of expertise and resources, industry partners enrich academic concepts by collaborating in implementation (6 responses), advising (4 responses), and consulting (3 responses). Moreover, they actively engage as facilitators (10 responses), guest speakers (11 responses), and industry mentors (11 responses), offering invaluable real-world insights. Occasional roles as guest lecturers (5 responses) and supervisors (12 responses) further enhance student guidance and mentorship. However, 19 responses

indicated no industry partner involvement, suggesting potential areas for expanded engagement. Overall, this highlights the multifaceted impact of industry partnerships in enhancing the quality and relevance of pedagogical activities at MUST.

4.1.5 Learning Outcomes and Competencies

The expected learning outcomes for pedagogical activities at MUST demonstrate a strong emphasis on holistic skill development such as; subject-specific knowledge acquisition which emerged as a prominent objective in the MUST CLE, followed by critical thinking skills development (32 responses) and problem-solving abilities enhancement (35 responses). Communication skills improvement (19 responses) and collaboration and teamwork skills development (23 responses) also received considerable attention. Moreover, practical hands-on experience acquisition (27 responses) and career readiness and employability skills development (19 responses) underscore the practical and professional orientation of these activities. However, there are 2 instances where no responses were provided, suggesting potential areas for clarification or further exploration. Overall, these findings highlight the comprehensive approach to fostering diverse competencies through pedagogical activities at MUST.

4.1.6 Areas for Improvement

The availability of resources emerges as a predominant concern, with 36 responses indicating a need for enhanced access to essential tools and materials to support effective learning experiences. Other notable areas include integration with other parts of the curriculum (20 responses), clarity of instructions or objectives (15 responses), and assessment or feedback mechanisms (15 responses), highlighting the importance of cohesive and well-structured learning frameworks. Additionally, coordination with external actors (18 responses) and scheduling or timing (11 responses) are identified as areas where improvements could enhance the overall effectiveness of pedagogical activities. Furthermore, considerations for engagement or participation opportunities (14 responses) and accessibility or inclusivity (8 responses) underscore the importance of fostering an inclusive learning environment. Overall, these findings offer valuable insights into areas where targeted interventions could optimize the quality and impact of pedagogical activities at MUST.

4.1.7 Familiarity with Problem-Based Learning

The analysis of data regarding familiarity and utilization of Problem-Based Learning (PBL) among lecturers at MUST, indicated most lecturers (66.7%), were both familiar with and had extensively used PBL in their teaching practices. Additionally, 13.3% are familiar with PBL but have not utilized it in their teaching, suggesting potential opportunities for further integration of this approach. However, 20% of respondents indicated that they are not familiar with PBL, highlighting a need for awareness-building and training initiatives to promote the adoption of innovative teaching methods. These findings underscore the varying degrees of familiarity and utilization of PBL among lecturers, indicating a potential for enhancing pedagogical practices through targeted support and professional development opportunities.

4.1.8 Opinions on Problem-Based Learning

The opinions regarding Problem-Based Learning (PBL) among lecturers at MUST revealed most lecturers (55.8%) to perceive PBL as highly effective in fostering critical thinking, collaboration, and real-world application of knowledge. Additionally, 30.2% of respondents considered PBL to be moderately effective, suggesting a favourable outlook on its merits, though with some reservations. Notably, there were no responses indicating a perception of PBL as not very effective. However, a small proportion, accounting for 7% of respondents, expressed no opinion or uncertainty regarding the effectiveness of PBL, indicating potential areas for further exploration or clarification. Overall, these findings underscore a positive perception of PBL among lecturers at MUST, highlighting its potential to enhance teaching and learning outcomes through active, student-centred approaches.

5 Discussion and Conclusions

A diverse range of collaborative learning activities (CLAs) were identified across the HEIs with different levels of engagement with industry partners. CLAs like Internships and field trips were common across HEIs while some CLAs like *Learn as You Earn (LAYE*) were unique and only being practised in Bugema University. While some CLAs like Internships could deliver high level of involvement of industry partners, these were mostly passive participants in other CLAs. Special projects were commonly implemented in the BU CLE, while MUST teachers implemented more group discussions and lectures. In the DEM-MAK CLE, more teachers are involved in co-supervision, internships, field trips, and guest lectures, while BU teachers are involved in industrial

attachments, field trips and special projects. Generally, more teachers are involved in the implementation of compulsory CLAs, across the partner universities as opposed to individually initiated CLAs such as guest lectures, group/cohort learning, and case studies. The multiplicity of CLAs could be by design to enable diverse experience of learners but could also highlight a symptomatic lack of structure through which collaboration with industry can be achieved.

A fully developed CLE should be buttressed by a formal commitment between the University and the industry partners stipulating the roles and responsibilities of each stakeholder but also clearly describing the expectations of each. While the framework for such commitments exists, only few of these agreements were reported by staff. As such most of the CLAs were implemented under informal agreements devoid of proper guidelines on roles, responsibilities and rights of partners.

For instance, while the University vision of Makerere University is to promote collaborative partnerships with partners and the general community in teaching and learning, the actual implementation of this vision is still left at the prerogative of the individual teaching unit (department) or even instructor. As such where an instructor regards delivery of teaching in collaboration with industry partners highly, the learners will experience more collaborative learning sessions than otherwise.

Overall, fewer teachers were involved in the execution of CLAs across the HEIs in Uganda and Malawi. This is largely attributed to a lack of expertise in the application and implementation of CLAs, limited resources, the absence of clear guidelines and less emphasis on CLAs in the design of academic programs. Additionally, most CLAs featured less frequently throughout the students' academic years, which hinders emphasis on acquisition of skills and abilities by students throughout their educational years at the university. The study indicated higher exposure of students to CLAs in their early educational years than later years, and this is partly due to emphasis on research competences in last educational years as opposed to enhancing continuous acquisition of skills, knowledge and abilities throughout the program lifecycle.

The study revealed more collaborations with research-based government partners than private business companies, communities and NGOs. The government actors only focused on enhancing acquisition of research, hands-on skills and placements for students' internships. There were no clear learning outcomes from the CLAs and the implementation was more adhoc than being explicitly planned. This scenario points to the need for developing deliberate institutional academic policies that further strengthens the integration and emphasis of CLAs implementation

by all teachers. Such measures like creating compulsory courses, effective monitoring in the delivery of courses, can be more effective.

The low involvement of teachers in the execution of CLAs should be addressed by organising deliberate trainings for teachers in the application and implementation of collaborative teaching and learning approaches such as; problem-based learning embedded with entrepreneurship and innovation approaches, use of case studies, simulations, and planning for external students' challenges, to strengthen the teaching and learning process in the CLE.

Since more students and teachers are involved in implementation of CLAs within the programs, the designing and establishment of compulsory courses on entrepreneurship and innovation should be emphasised to ensure a wider exposure of students to key entrepreneurial skills, knowledge and the right mindset. However, even with the existing collaboration arrangements between universities and government industry actors may require further analysis to encourage co-creation of knowledge, exposure of students to real-life challenges and increase the level of students' engagement in the competence-based teaching and learning process.

Finally, the presence of diverse CLAs across the universities offer great hope for significant improvement in delivery of competence-based education to students through strengthening their support for educational infrastructure, university-industry collaborations and professional networks. However, further investigations are necessary to establish concrete measures on how to strengthen the CLEs across the African Universities including those in the southern and eastern Africa. Therefore, strengthening collaborations with external partners, refining pedagogical methods like Problem-Based Learning, and ensuring resource availability are key strategies for improvement.

6 Recommendations for the Development of University-based CLEs in Africa

To enhance the effectiveness of CLEs across the partner universities, the following considerations are important: Firstly, there is a need to strengthen the training on the designing and implementation of Problem Based Learning (PBL) embellished with entrepreneurship and innovation approaches among all lecturers in the partner universities. Workshops and training sessions should be provided to increase familiarity and effective implementation of PBL methodologies. This will empower lecturers to adopt student-cantered approaches, fostering critical thinking and real-world problem-solving skills among students.

Secondly, strengthening external collaborations is crucial for enriching the practical relevance of pedagogical activities. The partner universities should actively foster partnerships with industry and community stakeholders to provide students with opportunities for hands-on learning experiences, industry exposure, and mentorship. This collaborative approach will bridge the gap between academia and industry, ensuring that students are equipped with the skills and knowledge demanded by the workforce.

Furthermore, improving resource availability is essential to support diverse teaching methods and activities. the partner universities should ensure that adequate resources and materials are readily available to facilitate interactive and experiential learning approaches. This includes access to laboratory equipment, technology tools, and other educational resources necessary for effective teaching and learning.

Lastly, enhancing curriculum integration is key to maximizing the impact of innovative pedagogical activities. The partner universities should develop strategies to seamlessly integrate PBL and other student-centred approaches into the curriculum. By aligning teaching methods with learning objectives and course requirements, the university can enhance student engagement, retention, and overall learning outcomes. The following recommendations to key actors in the CLEs require attention:

(a) University Teachers: should deliberately embrace the planning to implement CLAs so as to facilitate faster acquisition of the required skills and abilities and competencies to their learners

(b) **Industry:** The industry should actively participate in providing necessary information used in profiling of the necessary skills for graduates and also get involved in knowledge co-creation, and the nurturing and training of graduates with specific needed competences by employers in the world of work

(c) **University management**: Deliberately embrace PBL methods and through strategic investment in strategies for effective delivery of competence-based curricula.

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