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Impact of the micro-research model on building research capacity in undergraduate health professions students in HIV-related research: a comprehensive evaluation using the RE-AIM framework

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Abstract

Background Low-income settings such as Uganda bear a disproportionately high burden of diseases such as HIV/AIDS, but contribute little to knowledge production to address their health challenges. The training of health professionals traditionally focuses on clinical skills with less emphasis on research; yet, in practice, health professionals are expected to do operational research. In this study, we evaluate the impact of a micro-research model on building the capacity of undergraduate health professions students to conduct locally relevant biomedical, behavioral, clinical, and operations research on HIV and its co-morbidities.

Methods This study was within the Health Professional Education Partnership Initiative - Transforming Ugandan Institutions Training Against HIV/AIDS (HEPI-TUITAH; 2018–2024), using a sequential explanatory mixed methods design. We collected quantitative data on sociodemographic, number of trainings, concepts and written manuscripts. Thereafter, we conducted in-depth interviews and analyzed them using a thematic content approach. We used the RE-AIM (reach, effectiveness, adoption, implementation, and maintenance) framework to evaluate the impact (number trainings, protocols written, manuscripts written, publications, and change in attitudes) of the HEPI-TUITAH micro-research model.

Results Of the 24 participants that were interviewed, 15 (62.5%) were male, aged 24–63 years (mean age, 35.3 years). Despite the challenges associated with the COVID-19 risk management measures, 41 (57%) out of the expected 72 manuscripts were published. Most participants expressed satisfaction with the recruitment process and the opportunities provided by the program. The process was described as transparent, competitive, and inclusive, allowing participation of multiple disciplines within the health professions training domains.

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The multi-disciplinary approach to team formation enriched the research process by leveraging diverse perspectives and expertise. Our data show that effective mentorship was a key driver of program success, facilitating skill development, fostering strong relationships, and ultimately contributing to the advancement of both mentees and mentors in their academic and professional pursuits. Training and mentorship sessions encompassed proposal development and manuscript writing. There was a general positive outlook regarding the sustainability at participating institutions.

Conclusion The micro-research model is a successful model for building research capacity for undergraduate health professions students. This model is highly recommended for integration into curricula for health professions programs.

Keywords HIV and its co-morbidities, Low-income settings, Undergraduate health professions students, Operations research

Background

Low income settings such as sub-Saharan Africa (SSA) bear a disproportionately high burden of disease but contribute little to knowledge production to address their health challenges, such as HIV/AIDS [1]. To change this trend, intentional strategies are needed, such as introducing targeted practical research in HIV/AIDS early in the training of health professionals. In Uganda, the training of health professionals has traditionally focused on clinical skills with less emphasis on research [2]. Yet, in practice, the health professionals are expected to do operational research and other investigations but with limited or non-existent resources and training [3]. Although there is significant improvement in HIV/AIDS research being conducted in Uganda, most of it is by a small number of senior researchers based in urban centers with very little input from health professions students [4]. Graduates from institutions in rural settings tend to stay and work in rural settings when compared to those from the urban settings [5]. According to a study in the USA at Miami University, introducing research skills early in the training increases the interest and later use of research [6]. Integrating capacity building for research in the training of health professions students, especially from rural-based universities, has the potential to increase locally driven, relevant research agendas [4].

HIV/AIDS is one of the well-researched diseases in Uganda but with little input from undergraduate health professions students. Some of the key areas for improving research capacity for HIV/AIDS research among students on research that addresses barriers to HIV/AIDS service delivery including (a) utilization of HIV/AIDS services in the community, (b) linkage between health facilities and the community, (c) social and community factors affecting adherence and retention, and (d) stigma and discrimination. In addition, training health professional students in resource-limited setting (RLS) should be hands-on with mentorship by faculty and senior researchers research projects that can be published with health professional students as the first authors [4].

While limited funding for research is one of the major hindrances for building research capacity in low resource settings, the micro-research model [7] has been found to be effective in generating locally relevant evidence for solutions to local health problems using available resources in communities. The micro-research model emphasizes multidisciplinary team and collaborative work to conduct research that can be published in international peer-reviewed journals. Micro-research was modeled on microfinance principles [7], whereby small easily accessible grants are given to members of a community to solve community problems/challenges and needs. It builds on existing networks and strengths, clinician scientist training programs, global health partnerships, local community knowledge and, community-based education research and service.

Mbarara University of Science and Technology (MUST) began using the micro-research model in 2008, awarding junior faculty research teams micro-grants to conduct small interdisciplinary research projects [4]. In this model, multi-disciplinary research teams are taken through a scientifically rigorous process of concept and proposal development before micro-grants are awarded. The HEPI-TUITAH (Health Professional Education Partnership Initiative-Transforming Ugandan Institutions Training Against HIV/AIDS) program was a 5-year program that aimed to promote locally driven research in HIV in Uganda using a micro-research grant model. In the HEPI-TUITAH program, each year, different inter-professional/multidisciplinary research teams were competitively awarded micro-research grants of up to \$3000 (US dollars) to conduct a 12-month mentored research project in HIV/AIDS. The awardees of the micro-research grants were undergraduate of medicine, nursing, pharmacy, physiotherapy, medical laboratory science, pharmaceutical sciences, nursing and public health. The selection of the research teams was done by the Program Implementation Committee (PIC), which had representation from the partner universities. The micro-research model has the following steps:

- Request for research concepts for micro grants
- Select applications that proceed to the next step- applications are reviewed and ideas within the priority HIV focus are selected
- Train health professions student teams in developing research concepts- student teams are invited to a 5-day training course with their research questions
- Orient mentors through the micro-research model
- Assign mentors to the student teams to support them in research proposal development and submission of the full proposal for evaluation and selection for award,
- Provide micro-grant and research implementation, and
- Disseminate the findings of the research projects.

In this study, we conducted an evaluation of the program using the RE-AIM framework (reach, effectiveness, adoption, implementation, and maintenance) to determine the impact of the HEPI-TUITAH micro-research model on the capacity of undergraduate health professions students to conduct locally relevant biomedical, behavioural, clinical, and operations research on HIV and its co-morbidities.

Methods

Study design

We used sequential explanatory mixed methods in which quantitative data (sociodemographic, number of concepts, proposals, publications) were collected first and analyzed. Thereafter, qualitative data were collected and analyzed in sequence to help explain the quantitative results, with the participants providing more in-depth views [8, 9]. The findings from the two phases were then connected to providing a general understanding of the RE-AIM domains of HEPI-TUITAH program [10].

We used the RE-AIM (reach, effectiveness, adoption, implementation, and maintenance) framework to evaluate the impact of the HEPI-TUITAH micro-research model on the capacity of undergraduate health professions students to conduct locally relevant biomedical, behavioural, clinical, and operations research on HIV and its co-morbidities. We defined the different terms as shown in the table below:

Reach	The number of people and percentage of the target population who are impacted, and the extent to which those reached were representative
Effectiveness	The measure of the impact on health, mental health, or the ability of participants to conduct and publish research in peer reviewed journals,

Adoption	The number and percent of providers/interventionists who participated, and the extent to which they were representative of the target population
Implementation	The level of adherence to program delivery as intended, including the extent to which domains were implemented and/or adapted, including the cost of delivering the program
Maintenance	The degree to which the program has been sustained (at the setting level) and to which the effects of the program have been maintained (at the individual level) [11].

Study setting

The study was conducted at the three HEPI-TUITAH institutions in southwestern (MUST, Bishop Stuart University-BSU) and northern (Lira University-LU) Uganda. Mbarara University of Science & Technology is a public university established in 1989 with a primary focus on science and technology training. Bishop Stuart University is a private, not-for-profit University in Mbarara City. Lira University is a public university located in Lira City in mid-northern Uganda that provides equitable higher education aligned with national development priorities. All the three partner institutions offer undergraduate health professions training, including medicine, nursing, pharmacy, physiotherapy, medical laboratory science and pharmaceutical sciences at MUST; nursing and public health at Bishop Stuart University; and midwifery, public health and community psychology at Lira University.

The HEPI-TUITAH program (funded by the National Institutes of Health [R25TW011210]) was designed to support training and mentoring activities at three rural health professional training institutions (HPTIs) in Uganda: Mbarara University of Science and Technology (MUST), Bishop Stuart University (BSU), and Lira University (LU) in collaboration with Massachusetts General Hospital (MGH) in the United States. The overarching goal of the program was to build capacity for undergraduate health professional training and research mentoring at the three HPTIs in the fight against HIV/AIDS and to conduct locally relevant research. Student teams were matched to mentors at their respective institutions based on alignment between student research topics and mentor expertise. The program provided research training opportunities to undergraduate health professions students at the three Ugandan HPTIs. We adapted the micro-research curriculum to the training needs of undergraduate students using a multi-step process for selecting micro-research grant recipient teams from MUST, BSU, and LU.

Participants

The micro-research activity involved three cohorts of micro-research student teams representing medicine,

nursing, pharmacy, physiotherapy, medical laboratory science, pharmaceutical sciences, public health, midwifery, and community psychology. A stratified, purposeful sampling approach was used to select participants for the end-line evaluation. Stratification was done by role (student team leaders, mentors, HEPI-TUITAH investigators, and program administrators) to ensure representation across all program levels. Within each stratum, participants were purposefully selected based on their level of involvement in micro-research activities, availability, and ability to provide rich information on program implementation and outcomes.

We included micro-research team leaders, mentors from the three cohorts, selected HEPI-TUITAH investigators, and program administrators. We also obtained data from documents collected between September 2018 and August 2023, including program activity quarterly and annual reports, the mid-term evaluation report, training attendance sheets, and publications from HEPI-TUITAH-funded research.

Recruitment process

Potential participants were contacted by phone and email to schedule in-person interviews. Individuals were approached sequentially within each sampling stratum until the required number of participants was reached. The study purpose was introduced to each participant, and written informed consent was obtained before the interview.

Data collection procedures

A total of 59 micro-research awards were competitively awarded through the HEPI-TUITAH program during the funding period. Across the 5-year grant period, three cohorts of micro-research teams were supported (24 in Cohort One, 20 in Cohort Two, and 15 in Cohort Three), each completing a 12-month cycle. Data extraction and interviews were conducted between April and August 2023 by an independent research assistant. Quantitative indicators were collected using a structured data collection form. Qualitative data were collected through in-depth, semi-structured interviews conducted in private settings at each institution. Interviews explored participant experiences with training, mentorship, research implementation, and perceived program outcomes.

Rigor

We utilized an experienced qualitative researcher as the external evaluator and research assistants to ensure high standards in data collection, analysis, and reporting.

Trustworthiness

We ensured that data collection methods and findings of our study would fit within our context and available

information related to micro-research. Moreover, our findings are applicable to other aspects of health professions education.

Data analysis

The qualitative data were analyzed with a thematic analysis approach [12] using both deductive (i.e., pre-identified themes based on the interview guide) and inductive (i.e., emergent themes from the data) approaches [13] with the assistance of NVIVO 14 software [14]. The final transcripts uploaded into NVIVO for analysis were based on the audio-taped materials, transcribed verbatim, and reviewed for accuracy. The analysis involved: (i) familiarization with transcripts; (ii) development of an initial coding framework based on the interview guide questions as well as codes emerging from the data; (iii) coding; and (iv) separate comparative analysis of the codes. In steps (i) and (ii), two analysts, ESO and MO, read five randomly selected transcripts and each did independent coding. To ensure acceptable inter-coder reliability, a meeting was then held between the two coders to discuss the coding framework. In steps (iii) and (iv), MO and ESO independently coded an additional 5 transcripts, and another meeting was held after which MO proceeded to code the rest of the transcripts.

For quantitative data, continuous variables were analyzed as means while categorical variables were summarized using frequencies and proportions.

Results

Socio-demographics

This study involved leaders of three cohorts of micro-research student teams (medicine, nursing, pharmacy, physiotherapy, medical laboratory science, pharmaceutical sciences, nursing, public health, midwifery, and community psychology), mentors from the three cohorts, selected HEPI-TUITAH investigators, and program administrators. Of the 24 participants that were interviewed, 15 (62.5%) were male, and 9 (37.5%) were female, and age ranged from 24 to 63 years, with the mean age being 35.3 (SD) years; the other demographics on education, role, duration of experience in the role, and cohort are as provided in Table 1.

Findings from the RE-AIM framework

Quantitative achievements are as presented in Table 2, where most of the targets were moderately achieved, except where the number of micro-research teams that disseminated findings at fora other than HEPI-TUITAH only achieved 12 presentations out of the expected 72.

Qualitative findings under the five RE-AIM domains

Participant quotes were labeled using a structured identification code to maintain confidentiality while

Table 1 Socio-demographic characteristics of the participants

Participants characteristics	N (%)
Education [<i>n</i> = 24]	
Bachelor's degree	11 (44%)
Master's degree	8 (32%)
PhD	5 (24%)
Role (<i>n</i> = 24)	
Health professional trainees	9 (37.5%)
Administrators	4 (16.7%)
Faculty	11 (44%)
Duration of experience in the role (<i>n</i> = 24)	
≤ 1 year	9 (37.5%)
2–5 years	5 (20.8%)
6–10 years	4 (16.7%)
≥ 11 Years	6 (25.0%)
Cohort [<i>n</i> = 23]	
1	4 (17.4%)
2	4 (17.4%)
3	3 (13.1%)
1 & 2	1 (4.3%)
1, 2 & 3	11 (47.8%)

Leaders who were involved in more than one cohort were only interviewed once

distinguishing roles and institutions. Codes combined a role descriptor, HPT (trainer), HPS (student), PRA (program administrator), or ME (mentor), with a letter indicating the institution: M for MUST, B for BSU, and L for Lira University. For example, HPT-M refers to a health professional trainer at MUST.

Reach

Perceptions of the HEPI-TUITAH micro-research teams' recruitment process

Most participants were satisfied with the recruitment process for the HEPI-TUITAH micro research teams, with participants across cohorts and institutions noting that the process met their expectations. They reported that the recruitment process had been well structured and effective in selecting diverse and multidisciplinary teams. Most of the health professions trainees expressed satisfaction with the opportunities provided by the program, including research training, mentorship, and research skill development. The process was described as transparent, competitive, and inclusive, allowing multiple disciplines within the health professions training domains.

According to participants, the selection process involved several stages, including screening, pitching, and concept development training. That, during

Table 2 Implementation outcomes of the micro-research model in the HEPI-TUITAH program based on the RE-AIM framework

RE-AIM domains	Indicators	Target	Co-hort 1	Co-hort 2	Co-hort 3	Achieved	Percent
Reach	No. of programs represented	11/cohort	11	11	11	11	100%
	No. of students	360	137	112	79	328	91%
	No. of research teams at concept development	90	30	30	90	60	67%
	No. of research teams at full proposal development	72	24	20	15	59	81%
	No. of research teams at data analysis & manuscript writing	72	24	19	13	56	78%
Effectiveness	No. of proposals developed by the end of 5-day proposal development training	72	24	20	15	59	82%
	No. of projects that completed data collection	72	24	19	15	58	81%
	No. of projects with draft manuscripts by the end of 5-day data analysis and manuscript writing training	72	24	19	15	58	81%
	No. of micro-research projects with peer-reviewed publications	72	17	13	11	41	57%
	No. of micro-research teams that disseminated findings at fora other than HEPI-TUITAH	72	7	4	1	12	17%
Adoption	No. of concepts developed	90	24	20	15	59	66%
Implementation	No. of Micro-Research grants awarded	72	24	20	15	59	82%
	No. of teams successfully mentored to manuscript submission	72	24	19	15	58	81%
	No. of successfully completed micro-research projects	72	24	19	15	58	81%
	No. of full proposals developed	72	24	20	15	59	82%
	No. of Micro-Research projects conducted	72	24	19	15	58	81%
	No. of Micro research projects with results	72	24	19	15	58	81%
	No. of manuscripts published	72	17	14	11	42	58%
	No. of presentations made at the HEPI-TUITAH research symposia	72	24	19	15	58	81%
	No. of HEPI-TUITAH Symposia	2	1	0	1	2	100%

Data source: HEPI-TUITAH program activity reports (trainers, monitoring and evaluation officer, mid-term evaluation, and annual reports)

screening, concepts were evaluated based on adherence to instructions and relevance to the HIV research focus. Importantly, the selected teams then underwent training to develop their concepts further, with the aim of creating clear and viable research proposals, which improved the quality of the mentored research.

This program was targeting people who were training to be health professionals. So, we were looking at medical, pharmacy, nursing, medical laboratory science and physiotherapy students. In other universities (Lira and BSU), there was a bachelor's in public health and community psychology (Lira). At each institution, co-investigators were informed to alert their students that something was coming up. So, I think they were on WhatsApp, email, one-on-one in lectures, and later on a call was shared, printed, and put on notice boards but also on email. (S3-MW-M-14)

I think a lot of attention was paid to making sure all the [health professions] students were involved in the training..., and the two genders as one of the eligibility criteria, ... I think that contributed to its success. (S3-HPT-M-28)

Like many activities at the time, the recruitment process of the HEPI-TUITAH micro research teams and the subsequent activities were affected by the COVID-19 pandemic, especially the activities taking place during the extended lockdown (March 2020 to 2022). During the lockdown period, movement restrictions and health protocols necessitated adjustments in study locations, workshop formats, and communication methods, while participants adapted by incorporating virtual elements into their activities and implementing COVID-19 risk management measures.

The recruitment process, I would say it was good but part of the time we found out it was affected by the times we were conducting this study for the period 2020, 2021 and I think 2022. The COVID-19 pandemic changed the working of the whole organization that there some sort of changed in the way things were done ranging from recruitment, doing the study, all the different stages of the studies were affected by COVID-19 disruption. (S3-ME-M-019)

Training sessions for micro research team

By and large, the training offered to the micro-research teams was perceived as beneficial in providing essential guidance on concept formulation by most participants. But it was noted that during the concept development training sessions, participants faced challenges associated

with large group sizes, limited interaction with facilitators, and difficulties in mastering and following the procedures. Challenges included time constraints and the need for individualized attention due to varying learning speeds among participants, leading to some team members dropping out.

So, in proposal development also, all the six people from the team were there; however, sometimes when we were developing the proposal, much of the load is left on the team leader and since these were new concepts, sometimes our colleagues when they see that there is a pressing issue, they are asking very tough questions to the team leader who is also fresh in the subjects. Some of them would disappear..., (S3-HPT-L-10)

Initially we had many students participating when they were developing their concepts and later on the numbers had to reduce because we had to drop people at the concept level. Later on, the numbers became small because we had selected fewer teams but generally there was a lot of interest from the students except when they knew they were not selected when you invite them for another training, they would not want to come knowing they are not part of the team that is going to be funded... (S3-ME-M-14).

Participants reported that the joint training sessions for proposal development involving multiple institutions facilitated knowledge sharing and learning from each other. The joint proposal development sessions were beneficial, but it was noted that initially only team leaders were involved, leading to some team members feeling demotivated. Despite these challenges, team leaders made efforts to ensure knowledge sharing among all team members through discussions and WhatsApp groups.

Joint proposal training was beneficial to me because we learnt from each other. As students, we learnt from each other, and also, we learnt from the trainers. ... Yes, we learnt as institutions. Then when we combined, we also shared knowledge, what someone could have understood that I had not understood, we got to share and got to inform ourselves. To me, it was a good idea for us to join. (S3-HPT-B-027)

Most participants reported that training in data analysis and manuscript writing was much more rigorous, with mentors playing a significant role in guiding the process. The main challenges at this stage included difficulties some teams experienced in integrating qualitative and quantitative data. There was also minimal contribution to the analysis and manuscript writing process from the

team members who did not attend the training, due to COVID-19 restrictions, where only the team leaders and one additional member per team were selected to attend training sessions.

HEPI-TUITAH made the decision to only pick team leaders to undergo the training. It was somehow challenging because it made some team members demotivated because all the program it was only the team leaders involved, and, in our cohort, Cohort 3, I think only team leaders benefited the most because it was only team leaders who were going for the training and I remember towards the last training, during analysis is when we were allowed to go with one other person: There would be a team leader and one other team member. (S3-HPs-L-23)

The COVID-19 pandemic posed significant challenges to the program, particularly in data collection and communication. Restrictions on movement and social distancing measures affected the ability to conduct in-person training sessions. However, efforts were made to adapt to the circumstances and ensure continued support for participants. The shift to online training presented issues with internet stability and participant engagement, further impacting the effectiveness of the sessions.

COVID-19, the way it affected our training, is that, as a team from the start, we started training as a team. So, along the way, we went into lockdown. So, for some of the training because of the restrictions on the numbers, some of the team members were not able to take part in the trainings. For example, data analysis and manuscript writing, other team members were not able to attend. Yes, we came back and shared the knowledge but when someone has got first-hand information is better than getting second hand. (S3-HPT-B-027)

Opinion on micro research team leaders' recruitment strategies

The recruitment strategies for micro-research team leaders varied among participants, reflecting diverse perspectives and experiences. The pitching process, where potential leaders presented their teams and research topics to a panel, was seen as the most effective by most participants. It was noted that, naturally, the person [student] who came up with the research idea became the team leader for the group.

I think what worked best is that the team leader is the one who had the vision so I think it worked well. The team leader is the one who had thought of the whole idea and generally is able to conceptualize it. I

had a team where the leader had to be changed and it was difficult to get the new team leader to give the same energy. (S3-ME-B-07)

Opinion on micro research team mentors' recruitment strategies

Most of the participants reported that mentors were chosen based on their expertise, experience in research, and previous involvement in similar programs. Criteria such as commitment, willingness to assist, and familiarity with the research topic were also considered. The recruitment process varied across cohorts, where in some cases, mentors were pre-assigned to teams, while in others, mentors had the opportunity to express interest in specific research topics or teams.

One of the things that worked was to look around and see who is doing research. Mentors doing their own research, which mentors are available and can be committed depending on how we know them in the institutions, which mentors can work in collaboration with others, which mentors have gone through the micro research training... I think there was some voluntarism although we had also been identified according to our research interests. (S3-ME-M-14)

Cohort sizes and mentorship arrangements evolved over time, with adjustments made based on feedback and program outcomes. While some cohorts had one mentor per team, others had two mentors, which facilitated teamwork and collaboration. Some challenges, such as mentor availability, commitment, and alignment with team goals, were noted. Suggestions for improvement included recruiting mentors from diverse backgrounds and disciplines, enhancing mentorship quality through training and incentives, and increasing mentor involvement in the team member selection process, however there were dissenting views on the mentor selection process.

For me, I had issues with that whole strategy of recruitment of the mentors because you just go there and they just give you a mentor you have never worked with when they appointed you, they got mentors who were at their disposal, and they tried to allocate mentors to the team... (S3-HPT-M-02).

Effectiveness

A 5-day training model

The evaluation of the 5-day training model utilized by the HEPI-TUITAH micro-research program reflected diverse range of opinions, pointing out both successful aspects and areas requiring refinement. Most of the participants and stakeholders offered valuable insights into the program's effectiveness, including that the selection

process of team leaders and mentors was reported to be transparent, and the proactive involvement of mentors garnered appreciation. This approach fostered a sense of ownership and ensured valuable support even before the training commenced. Both onsite and residential training formats were reported to have their advantages.

I liked it (5-day training) because it was able to deliver. I didn't know you could write a proposal in five days... I benefited a lot and the trainers were experts and they gave you an idea of how to get something good in a short time and I have actually used the same method to do the rest of my work. I liked the 5 days of training out of your work place and then also being effective and then you have deliverables. Content was very good; facilitation was very good. (S3-ME-B-07)

Also, most of the participants suggested various areas that would need improvement in future similar programs. It was noted that the intensive nature of the 5-day training schedule proved challenging for some participants, leading to stress and sleep deprivation. Some participants noted that they were made to adjust the working hours to alleviate mental strain and improve information retention. Participants recommended increasing the number of facilitators or extending the training duration to allow for more comprehensive feedback sessions.

In proposal development it was effective although it was heavy; that was a lot of work, and I thought it should be done in a course yet here we did it in one week and the knowledge had to be applied if one was to publish. I don't know about the mentors since most were researchers but for us, we were up-coming researchers so at the end of the week it was hectic but we had learnt. The content was a lot though needed. (S3-HPT-B-03)

Participants noted that onsite training offered proximity to university resources, while residential training facilitated social bonding and minimized distractions, enabling participants to concentrate solely on the training. The training facilitators were lauded for their competence and adaptability in catering to diverse learning styles. Their practical expertise guided participants effectively through the research process, enhancing the overall learning experience.

Onsite is that you can do some other work alongside the trainings, that if I have had a training during day time, I can have some small time to do a classroom discussion with my colleagues who are

around... Then for outside, the good with that was that we would see the new environment and we would also have new people come in there to teach us more, and the facilitation, we would even sleep better, you are having everything, quite excellent but you would lack this extra touch from other people who were outside the program who might help you somewhere. (S3-HPS-L-10)

Mentoring experience

The participants observed that effective mentorship was the basis for the program success, where it facilitated skills development, fostered strong relationships, and ultimately contributed to the advancement of both mentees and mentors in their academic and professional pursuits. Most of the participants reported a range of experiences and perspectives regarding the effectiveness of mentorship and its influence on program outcomes. They revealed that at each stage (proposal development, data analysis and manuscript writing), mentorship approaches and styles ranged from very supportive, actively engaged, and cooperative to passive and less engaged. Effective mentors were praised for their guidance, cooperation, and availability, which facilitated the creation of high-quality research outputs. Participants credited the mentorship program with enhancing their research skills, confidence, and professional networks.

I think the HEPI-TUITAH really helped to improve my mentorship because we had short trainings on how to be good mentors. We were trained on the mentorship process and some challenges of mentorship and given tips on how to overcome them and I thought that was good as well as this mentorship was concerned. Up to now the mentees I mentored, we continue to work together, one of my mentees is an assistant lecturer at a university and we have applied for a grant together. We have written two manuscripts together after HEPI-TUITAH. So, I think the mentorship has helped me build a deep relationship with my mentees which I think is good thing. (S3-ME-L-25)

However, challenges arose when mentors were perceived as distant, passive, or uncooperative, impeding progress and causing mentee frustration.

You have a mentor, the interaction is less, personally me I had a very good mentor, my HEPI-TUITAH mentor was amazing, was perfect, and was supportive. But I had two mentors, one was very passive actually... as a mentor he didn't really support, he was very busy, he never had time for me, he

never had time for the team, that is not mentorship.
(S3-HPT-M-02)

Recommendations for mentoring improvement included enhanced mentor training, optimized mentor-mentee matching processes, and the cultivation of a collaborative and supportive mentorship culture.

I think for me it did; it was easy I didn't have any challenges with my mentees... because of the trainings, people knew what to expect as a mentor and what to expect from my mentees and so it worked well... Trying to be accommodative, and guide them, and that's what I achieved... you take suggestions you don't dictate. (S3-ME-M-39)

Unexpected experiences in the micro-research model

Many HPTs were surprised by the rigorous research process and the diverse perspectives of reviewers. Participants noted the challenges encountered during manuscript writing and submission to peer reviewed journals, especially the multiple rejections from journals before their papers were eventually published. This process was both challenging and educational, offering valuable lessons, including journal selection. Despite challenges, participants expressed pride in their achievements and appreciated the opportunity to contribute to meaningful research outcomes.

The journey to my manuscript publication, ... initially after we had finished writing our manuscript, we submitted to the first journal.... which declined the manuscript ... they sent back to us the feedback and told us we might not be able to publish it because it was not so much in their field. So, they advised us to submit to a different journal, ... we submitted to a second journal but they delayed to give us any feedback...so, we wrote to them and told them that we were withdrawing the manuscript. We then submitted the manuscript to another journal who gave us feedback after about a month, they sent us comments from the reviewers, we responded to their comments and then like in two weeks' time, our manuscript was published (S3-HPT-B-27).

Adoption

Use of skills gained from the training

Some of the participants reported using the skills for publications and to write successful grant applications and secure funding for their research activities.

To me as an individual, the training was very satisfying, and I benefited a thousand-fold. Through the training I gained skills... I got my first publication

from the training and of course I have used the same skills and right now I have a few publications. I got new friends from different universities, and these are still friends up to now, then the mentor-mentee relationship, the communication. Generally, the micro-research program was so beneficial and important to us. (S3-HPT-M-20)

General perceptions/HEPI-TUTAH micro research model

Most participants agreed that the 5-day duration of the training was generally adequate but challenging due to its intensity. They acknowledged the comprehensive nature of the content covered during the training.

The five days training was enough for joint training because within those five days we were able to come with all updates though you may get tired because during the program we were also studying so you find if you have spent more than five days outside the University you may find that you have missed a lot. (S3-HPS-L-23)

Feedback on content coverage was mixed, with some participants praising the comprehensive nature aligned with training objectives, while others suggested improvements, such as incorporating more hands-on practice with data analysis software, and for a longer period of around two weeks.

The ideal would be dependent on the trainees. I may not identify the time that would be enough but depending on the number of trainees that were there, two weeks would have been enough. (S3-HPT-M-20)

Utilization of research skills

All participants noted that the skills acquired from the program have been instrumental in career advancement, with participants securing roles as research assistants, teaching assistants, and mentors. They have also leveraged these skills to contribute to institutional development and raise the profile of their respective universities through participation in conferences and the publication of research outputs.

Like I told you I did further training in medical education. I am working as a teaching assistant at some University, I am also working as a tutor for diploma students who are doing research. I am currently being engaged as a tutor for their research so in line with that I teach the concepts borrowing from what I was taught to these people and I am telling you, I am always asking for their feedback on how I am doing content delivery and some of them say it is good...I use the experience that I got from HEPI as one of the

tools to get me better other opportunities in line with research. (S3-HPS-L-10)

I have maintained a good relationship with my mentor from HEPI-TUITAH and some of my team members and we have gone ahead to work on some projects together. My mentor has helped me in submitting some of the work for the conference even beyond the duration of the program, he has recommended me for work beyond the HEPI-TUITAH program. (S3-HPT-M-28)

Implementation

Adherence to the micro research model/HEPI-TUTAH

The implementation fidelity of the HEPI-TUITAH micro-research model was assessed across various program key components; the formation of undergraduate research teams from diverse disciplines, gender mix and expertise. Participants appreciated the fact that, although the initial plan aimed at 15 teams, the actual numbers varied across cohorts due to adjustments because of the COVID-19 pandemic, which also affected the data collection sites.

Concerning micro research ... we stuck to the initial plan and during the process, the plan was supporting health professional students to undertake research under the micro research grants, so what I remember when the time for implementation came, an advert would be rolled out to the public across the three institutions, MUST, BSU and Lira University. In the advert details of the topics in which the students are supposed to develop their concepts were outlined ... given guidance on team composition ... to have a multi-disciplinary component ... from the different courses [programs] ...and also observe gender balance. Once they have been selected for funding, of course you have gone through the pitching, then you are now selected to participate in full proposal development. (S3-PRA-M-31)

Training and mentorship sessions encompassed proposal development and manuscript writing, conducted both onsite and offsite. Mentors were matched with teams based on expertise in HIV research. Data collection and analysis were collaborative efforts between teams and mentors throughout the research process, with roles divided among team members. The analysis was facilitated by both mentors and external trainers. The dissemination of findings occurred through conferences where teams presented their work to stakeholders.

I think most of the things that needed to be done were accomplished, apart from the team that I told

you about in cohort two, where they were not able to complete, but we were able to accomplish most of the things. We needed to train everyone including the team leaders and their members but that was not done because of COVID 19 as we wouldn't bring everyone on board due to the restrictions that were there by that time. (S3-PRA-B-02)

Maintenance

Sustainability/institutionalization of the micro-research model

Generally, participants reported that there has been a considerable level of support and commitment from institutions and mentors towards the continuation of undergraduate student research and publications. Mentors have played a significant role in this commitment, providing guidance, encouragement, and even recommending students for opportunities. Although financial constraints pose challenges for sustainability, participants proposed that to address these challenges and enhance support for undergraduate research, efforts could include securing additional funding, implementing mentorship policies, and promoting student-led research initiatives. There was also a call for increased funding and resources to sustain the program's activities, as well as integrating micro-research training into undergraduate curricula.

These undergraduate institutions get money for research, now I think it would be a better thing they borrow from the HEPI-TUITAH program that the money for research should equally come down to build capacity of the undergraduate students because if these students do some bit of facilitation coming through to help them, they will take research as a big tool that we can use to reshape and change society and do even bigger things that people can ever imagine...(S3-HPS-L-10).

I may not say it [sustainability] is there or not, because it's a little bit an administrative issue, but generally our local institutions are always underfunded in terms of research because for the four years I spent in the institution, this was one of the unique opportunities that we had. The sustainability of this would be if they got another grant, it could help students because there is not another way I see that the university can sustain this because of the financial constraints. (S3-HPT-M-20)

Recommendations

Most participants provided valuable insights into what is needed for stakeholders to find the HEPI-TUITAH micro-research model meaningful and how to enhance

its visibility and impact. They highlighted the importance of engaging key stakeholders in higher education to disseminate outputs and lessons learned from the program. Some of the key stakeholders identified were university administrators, government ministries, and research institutions. Generally, stakeholders expressed optimism about the potential of the HEPI-TUITAH model to foster undergraduate research and urged continued support and investment to realize its full impact.

The more publications the more visibility so people get to know what one is doing. If people in our university became serious and published it would be more meaningful and would encourage the person that won the grant to fund these proposals, knowing that some work had been accomplished. At the end of the day the indicator is a publication. (S3-HPS-B-03)

One of the things that needs to be done is community engagement, the project came and it benefitted me because I remember we were doing research to improve the community so the only way to always engage with other people in the community ...such that they get to know that yes undergraduate students are also able to do something when they are mentored. (S3-HPS-L-11)

We may need to ensure we publicize the model as much as possible so that others can know. Initially undergraduates were considered to do basic research that could not be anywhere but the HEPI-TUITAH micro research has shown us that these undergraduates can actually be mentored into researchers. (S3-ME-L-25)

Discussion

In this study, we used the RE-AIM framework to evaluate the impact of the HEPI-TUITAH micro-research model used on building the capacity of Ugandan undergraduate health professions students to conduct locally relevant biomedical, behavioral, clinical, and operations research on HIV and its co-morbidities. The findings are summarized using the RE-AIM framework. We found that most participants were satisfied with the recruitment process across institutions (163 from MUST, 93 from LU and 72 from BSU). At the end of the 5-day data analysis and manuscript writing training, 58 (81%) of the projects were completed. The participants expressed satisfaction with the opportunities provided by the program, including research training, mentorship, and research skill development. The process was described as transparent, competitive, and inclusive, allowing participation of

multiple disciplines within the health professions training domains. Despite the challenges associated with the COVID-19 risk management measures, the participants were able to adapt virtual elements into their activities, complete the research, and produce a total of 41 (57%) publications out of the expected 72.

Reach

The multi-disciplinary approach to team formation enriched the research process by leveraging diverse perspectives and expertise; it was beneficial for enhancing collaboration and knowledge exchange across different academic disciplines [4, 15]. Training mentors on the micro-research model and program expectations was strategic in ensuring they were well equipped to guide the mentee teams effectively. Recruiting mentors from diverse backgrounds and disciplines enhanced mentorship quality through training and incentives [16, 17].

Effectiveness

The training model utilized by the HEPI-TUITAH micro-research program reflected a diverse range of opinions, pointing out both successful aspects and areas requiring refinement [18]. This approach fostered a sense of ownership and ensured valuable support even before the training commenced [19]. The use of competent and adaptable facilitators was useful in catering for the diverse learning styles of the trainees consistent with findings from global capacity-building programs [20].

Adoption

Our data show that effective mentorship was a key driver of program success, facilitating skill development, fostering strong relationships, and ultimately contributing to the advancement of both mentees and mentors in their academic and professional pursuits [17, 21]. Mentoring relationships emerged as pivotal for refining research outputs. Studies show that the mentor-mentee relationships not only offer academic and research-related guidance but also foster personal and professional growth [11, 22]. Participants commended mentors for their support, knowledge-sharing, and creation of a conducive learning atmosphere, which ultimately contributed to their success in the program.

In addition, most participants in our study reported having effectively utilized the research skills gained through the HEPI-TUITAH micro-research program in various ways. Many have continued to engage in research activities, such as writing and publishing papers and presenting findings at conferences. Some of the participants reported having applied the acquired skills to peer mentoring, teaching research concepts, and supervising students' research projects. A few reported using the skills to write successful grant applications and secure funding

for their research activities. This is evidenced in other studies showing that the skills acquired from the mentorship programs have been instrumental in career advancement and job opportunities [11].

Implementation

The implementation fidelity of the HEPI-TUITAH micro-research model was assessed across various key components [4]. Training and mentorship sessions encompassed proposal development and manuscript writing, aligning with evidence that structured, phased training improves learner engagement and research output [17]. The process involved students undergoing training in concept development, with mentors becoming involved during proposal development. Mentors were matched with teams based on expertise in HIV research [18]. Data collection and analysis were collaborative efforts between teams and mentors throughout the research process, with roles divided among team members. This collaborative approach reflects findings from other LMIC research-capacity programs showing that shared responsibility and iterative mentor feedback strengthen methodological rigor [20]. The dissemination of findings occurred through conferences where teams presented their work to stakeholders, including university representatives and health organizations. Brief reports were also shared with communities where data was collected. Collaborative efforts between students, mentors, and partner institutions were key to the model's success, thus making implementation fidelity an important factor in interpreting outcomes in intervention programs [23]. Our findings are consistent with the literature highlighting the importance of multi-institutional partnerships in sustaining research-training initiatives [17].

Maintenance

Most participants reported that there was a considerable level of support and commitment from both institutions and mentors towards the continuation of undergraduate student research and publications [20]. Mentors demonstrated dedication to guiding students through the research process, but their continued support was sometimes affected by time constraints and other responsibilities. There was a general positive outlook regarding sustainability at the participating institutions. However, participants were quick to acknowledge potential challenges such as financial constraints and time limitations, which may impact the level of support provided by both institutions and mentors [24]. Efforts to address these challenges and enhance support for undergraduate research could include securing additional funding, implementing mentorship policies, and promoting student-led research initiatives [17, 25]. The aspect of interdisciplinary professional work was nurtured throughout

the program, building synergies across the different professional abilities and capacities, and enhancing teamwork and overall team-focused deliverables [4, 8].

Strengths and limitations

We had planned to train teams in all aspects of research, from concept development to article publication. However, the COVID-19 pandemic interfered with the process, and we trained a smaller number of participants through all the stages [9, 18]. Some team members missed training on manuscript writing.

We were able to go on with the project despite several challenges. We published 41 (57%) articles in scientific journals with undergraduate students as first authors. Undergraduate students demonstrated gained skills in mentoring others and applying for grant opportunities.

Our findings are in agreement with previous micro-research studies [10, 26], which indicated that the model is applicable for research-naïve individuals and that it can be utilized in resource-limited settings.

We interviewed a few of the trainees of the program, especially team leaders in the program. It would have been good to get the views of the other trainees as well, but most of them had already been dispersed for internship placements.

Conclusions and recommendations

The micro-research model is a successful model for building research capacity for undergraduate health professions students. This model is highly recommended for integration into curricula for health professions programs.

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12909-026-09763-x>.

Supplementary Material 1.

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Authors' contributions

GZR, CO, EKW, SM, EK, JK and JEH conceived the original HEPI-TUITAH program and acquired the funding with CO as the PI. EO, CKK, JG, MO and PK took part in data coding, analysis and interpretation. GZR wrote the first full draft manuscript. All authors critically reviewed the manuscript and agreed upon the final version.

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Data availability

All data are presented within the manuscript.

Declarations

Ethics approval and consent to participate

Ethics clearance was obtained from the Gulu University Research Ethics Committee (GUREC) under Ethical approval Number GUREC-2023-528. The study was also registered with the Uganda National Council for Science and Technology (UNCST). Waiver of consent was sought from GUREC for the document review. We sought and obtained written informed consent from all individuals who took part in the study. Access to the program documents during the desk review was restricted to only the research assistants/data clerk and the second last author (ESO), the external evaluator. To protect the privacy of the participants, no personal identifiers were collected during the data collection process. All interviews were audio recorded upon receiving verbal consent from the individual participants and backed by field notes. These interviews were done in private spaces at the participants' workplaces. All data collected during this evaluation and were stored under lock and key. Any electronic information was stored on a password-protected computer.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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