Hackathons as essential tools in an interdisciplinary biological training - report from trainings for Sub-saharan students

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Abstract

Hackathons are collaborative, fast-paced events where participants from various fields work together to solve real-world problems. The term combines "hack" and "marathon," reflecting both the creative and intensive nature of these activities. Emerging evidence highlights the benefits of hackathons as educational tools, particularly in engineering, software development, and social sciences, where they enhance problem-solving skills, teamwork, and engagement. Here, we extend this body of evidence by presenting our experience integrating hackathons into biological education. This report shares insights from two summer teaching events in Kenya (2022 and 2023), where over 50 participants from five sub-Saharan countries engaged in computational biology hackathons. These events aimed to train and support early-career researchers with little to no prior experience in computational tools. We discuss our motivations, teaching philosophy, program design, student feedback, and key outcomes, offering practical suggestions for educators on integrating coding and hackathons into their teaching to foster interdisciplinary learning and applied problem-solving in biology.

Keywords: authentic learning, challenge based activity, datathon, education, modeling

Introduction

The rate at which life sciences progress in today's world is not limited by the amount of data available but rather by our ability to process it. It is estimated that 402.74 million terabytes of data are generated globally every day [1]. To visualize how much data that is, imagine handing out a smartphone, completely full of apps, pictures, messages, files, and video, to every third person on the planet, every day[1]. Specifically in biology, technological advances such as in omics led to an unprecedented creation of data, with the Eli and Edythe L. Broad Institute of MIT and Harvard (Broad Institute), a biomedical and genomic research center, alone producing nearly 20 terabytes of genomic data every day[2]. However, making sense out of the data and answering relevant and

[1] assuming current population size to be 8.2 Billion and storage of a typical smartphone to be 128 GB
[2] `https://www.broadinstitute.org/data-sciences-platform/production-data-processing`, accessed 2024-09-19

disruptive questions, pushing the boundaries of what is known so far, requires the collaboration of experts in life sciences and data [2]. Enhanced collaboration has the potential to bring fresh impetus to research, fostering imaginative approaches and opening avenues for new theoretical insights, sometimes claimed to be missing [3]. While some scientific fields focus on refining existing knowledge through precise methodologies, collaborative efforts can accelerate innovation and deepen our understanding across disciplines. Collaboration is not simply about bringing people into the same room and hoping that they will identify both the problem and the solution. To effectively work together, we need to teach and cultivate a shared understanding and a common language, fostering smooth communication and collaboration at the intersection of diverse disciplines—an essential 21st-century skill emphasized by [4, 5], or more recently, by frameworks like those from the Report by the World Economic Forum.

Hackathons are a great stepping stone for building effective collaborators, as their solution-oriented and time-constrained nature requires effective communication to be successful [6]. The term "hackathon" is a combination of "hack" (referring to exploratory programming or creative problem-solving) and "marathon" (symbolizing the intense and time-bound nature of the event). Historically, "hack" comes from the MIT Tech Model Railroad Club in the mid-20th century, where members used the term to describe clever or experimental solutions to technical problems. Over time, it became associated with finding inventive ways to solve challenges, often by rethinking existing systems or constraints and pushing boundaries to achieve new outcomes. The first recorded hackathon took place in 1999, organised by the OpenBSD to develop new software technology and test digital solutions within a short time frame [3]. However, over time, the concept of hackathons expanded beyond IT and was adopted in different disciplines. A prominent and recent example was the #WirVsVirus hackathon, organized by the German government in March 2020 in response to the outbreak of the COVID-19 pandemic. In only 48 hours, more than 28,000 registered participants worked together on more than 1,500 solutions to pandemic-related challenges, including healthcare, remote education, and social distancing tools[4]. Along other events, such as NHS Hack Day (United Kingdom), MIT Hacking Medicine (USA), or numerous datathons (similarly to hackathons, datathons focus on problem-solving, collaboration, and innovation, but their primary focus is centered around data analysis), focusing primarily on data-derived insights and building models from data [7, 8], these initiatives show the growing trend of using tech-driven innovation to solve complex challenges in healthcare, from disease outbreaks to patient care improvements [9]. But hackathon events are not always purely focused on coding. An excellent example is a humanitarian hackathon organized by PORT at the heart of CERN in Geneva, Switzerland. The goal of PORT hackathons is to conceptualize an innovative idea to a provided challenge so "that the best ideas survive and can be driven forward after the event". The ongoing partnerships and interest from organizations like the International Committee of the Red Cross (ICRC) suggest that several initiatives have indeed progressed beyond initial prototypes. In an extended-format hackathon, participants are encouraged to develop communication skills with individuals from outside their direct field while working on solutions. While hackathons may not allow for a full mastery of these skills in a short timeframe, they provide an environment where participants with diverse backgrounds can apply and refine their existing communication abilities. The presence of mentors who have already mastered cross-disciplinary communication is crucial in guiding participants and sparking interest in unfamiliar fields. This mentorship helps bridge the gap between disciplines, fostering a deeper understanding and collaboration. However, it is necessary to mention that the role of mentors needs to be explicitly stated at the

[3] `https://www.openbsd.org/hackathons.html`, accessed 2024-09-19
[4] `https://wirvsvirus.org/`, accessed 2024-09-20

beginning of every hackathon, as it is not to be assumed that the expectations towards this particular role are always clear to the participants [10]. Beyond communication skills, hackathons offer benefits such as fostering teamwork, problem-solving, and creative thinking under pressure, making them accessible to a wide range of personalities and skill sets.

Why hacking for education

Hackathons have emerged not only as powerful research [11] but also educational tools, fostering teamwork, creativity, and real-world problem-solving skills while making learning more engaging and practical [12]. They meet important psychological needs for competence, autonomy, and relatedness, as outlined by the Self Determination Theory (SDT) [13]. The sense of **competence** is achieved mainly thanks to the philosophy behind the hackathon that is close to the pedagogical approach named Project-based learning (PBL) [14, 15]. PBL is an instructional approach where students, rather than passively receiving information, engage in a hands-on process of discovery, investigation, and problem solving to create a final product or solution [10]. Hackathons challenge participants to apply, expand, and pass on their skills in authentic real-time problem solving, allowing them to demonstrate their abilities in a practical setting. As participants attempt to solve real-world problems, these skills are relevant for the 21st century [16]. In addition, thanks to an active role of mentors, they receive immediate feedback as they build, test, and iterate their solutions, which helps them recognize their growing competence. This hands-on, high-paced environment fosters a sense of achievement as individuals tackle complex problems, enhancing their confidence and mastery of their skills [12]. Since the participants are given freedom to choose how they approach the challenge, they get an immediate sense of **autonomy** in how they work within their team. For example, participants in hackathons must decide which tools, technologies, and methods they want to use independently, which encourages creativity and self-directed learning. This freedom to experiment and take ownership of their projects helps foster intrinsic motivation, as individuals feel more in control of their learning process. Finally, since hackathons are highly collaborative events, they experience **relatedness**, as participants from diverse backgrounds come together to solve a real-life problem [17]. In this, they create a strong sense of community and belonging, as well as purpose.

Where to start and how to include hackathons in the program

Over the years, we, the authors of this communication, have first participated, and then conducted several hackathons in diverse settings. Our primary goal was to enable our students to use their computational skills to solve real-world problems. By fostering an environment that encourages free learning and idea exchange, and by providing practical examples, we observed that students gained a strong sense of achievement upon recognizing their ability to tackle practical challenges. While hackathons offer significant opportunities for innovation and learning [18], the rapid pace and diversity of participants can lead to communication barriers. Differences in terminology, methodologies, and disciplinary perspectives may hinder effective collaboration.

To mitigate the problem of lack of a common language between groups, we encourage implementing hackathons as the end event of a longer teaching endeavor, such as workshop, summer school, or even a semester-long course. In fact, hackathons and workshops share a common foundation in their ability to foster a hands-on learning environment, in line with the benefits of active learning [20]. While hackathons emphasize rapid innovation and problem solving [18], workshops offer a more structured and guided approach to building specific skills. Together, these formats complement

Component	Description	Teaching objective	Case Study 1 25 hours	Case Study 2 14 horus
1. Introduction & Background	Introduction to the data structure, description of the content, setting the goal.	Participants will ... **identify** key data features and **explain** the context and objectives of the task.	60 minutes 8 - 9 Day 1	60 minutes 14 - 15 Day 1
2. Individual work	Brainstorming, analysis, and applying core skills to explore the dataset.	... **apply** analysis techniques to **explore** the dataset and document their findings for discussion.	**4 sessions** 9 - 12 Day 1 13 - 18 Day 1 19 - *open end* 10 - 13 Day 2	**2 sessions** 15 - 18 Day 1 8 - 14 Day 2
3. Check-up sessions	Mentoring and support by instructors.	... **analyze** their progress and **evaluate** their approach with instructors' guidance to refine their methods.	Every hour 5 - 10 minutes	Every hour 5 - 10 minutes
4. Plenary sessions	Exchange of information between groups using peer review method.	... **evaluate** peer contributions, **compare** approaches, and **integrate** feedback into their projects.	**three sessions** 12 - 13 Day 1 18 - 19 Day 1 9 - 10 Day 2	**one session** 18- 19 Day 1
5. Presentation	Creation and design of the presentation catered to the target audience.	... **synthesize** their analysis into a coherent narrative, **design** visuals, and **deliver** an engaging presentation.	**5 hours** 2 h preparation + 3 h dissemination	**3 hours** 2 h preparation + 1 h disseminatin

Fig 1. Structure of a Hackathon. Recommendation for organizing and holding a successful hackathon for education. Ensure that five critical components are present, regardless of the length of the planned event, starting from providing the context for the challenge and finishing with a proper dissemination of the final results to the most relevant stakeholders. The proposed teaching outcomes of each component are outlined according to Bloom's Taxonomy of Educational Objectives for Knowledge-Based Goals [19] and the exemplary allocation of time is provided based on the experience from the two presented here case studies.

each other in powerful ways. Hackathons, with their fast-paced, dynamic environment, provide an opportunity to apply the knowledge and skills gained from workshops or intensive learning sessions like summer schools. By combining the depth of skill development from workshops with the creative, solution-focused nature of hackathons, participants can solidify their expertise while learning to navigate interdisciplinary challenges in today's data-driven world.

Teaching philosophy "No One Left Behind"

To ensure all participants could fully engage and succeed, we adopted a teaching philosophy centered on inclusivity and support. Below are key recommendations for implementing this approach:

- **Hands-on Learning:** Structure teaching blocks with extensive practical sessions to allow participants to apply and consolidate new concepts immediately.
- **Trainer-to-Participant Ratio:** Maintain a ratio of approximately one trainer per 10 participants, with at least two trainers in the room at all times.
- **Progress Monitoring:** Incorporate frequent checkpoints to confirm that participants can reproduce examples and solve exercises independently on their own devices.
- **Peer Support:** Encourage faster learners to transition into a mentoring role, fostering teamwork and collaborative learning.

This method not only enhances individual understanding but also builds a collaborative and supportive learning environment, benefiting all participants.

Putting theory into practice

While an increasing number of studies propose hackathons as effective teaching tools across various disciplines [21, 22], with majority of work steaming from the Human–computer interaction research [23], there is scarce information from practitioners on how to organize such events or what kind of tangible results they bring [12, 24]. In the following, we describe our experiences with hackathons from two case studies that took place during our independent teaching events held in Kenya in 2022 and 2023. Both events targeted young researchers and were designed based on the principles of **authentic learning** [25], combining traditional classroom activities, such as lectures and exercises, with real-world contexts. Students were required to solve meaningful problems through active engagement and interdisciplinary collaboration. First event centered on analyzing real-world data in close collaboration with a local non-governmental organization (NGO), while the second one relied on literature-derived and simulated data, demonstrating the flexibility of this format when direct access to field data is not feasible. Despite differences in timing and data sources, both events followed a similar structure, as outlined in Figure 1, and highlighted the value of hackathons in promoting problem-solving skills and teamwork in diverse educational contexts.

Case study 1: Summer School 2022, Watamu, Kenya

In 2022, we held a two-week summer school in Watamu, Kenya, to teach computational biology methods for marine conservation. Researchers from German, Italian, and Kenyan institutions collaborated on this "Computational Biology for Sustainable Environmental Research" program. Over two weeks, our group of more than 30 participants (trainers, lecturers, local facilitators, and 25 selected early career researchers) from fields like marine science and food security worked together to support sustainable environmental efforts (Fig. 2). The program featured speakers from mathematics, systems biology, and marine biology, ensuring a cross-disciplinary approach. Participants engaged in a comprehensive workshop that included programming, data analysis, and modeling, all conducted using open-source languages such as R and Python to promote accessibility and sustainability (full program in the Supplement Figure S1). The workshop combined lectures, hands-on sessions, and group projects, fostering insights into ocean science and sustainable solutions for climate change. This experience also laid the groundwork for future collaborations, exemplified by Case Study 2 with an integrated hackathon led by a previous participant. A competitive selection process, with nearly 100 applications from 12 Sub-Saharan countries, ensured highly motivated participants, boosting engagement and results. The evaluation was based on the 90-second motivation video submitted, the résumé, and the completed online application that included answers to the following questions: 1) Briefly describe your current research topic, 2) How will this summer school improve your research profile and enhance your future career prospects?, and 3) What do you consider to be the most important factor in sustainable research? This selection process was key to the success of both the computational school and the hackathon, as research shows that people are more engaged and motivated when they feel they have been intentionally chosen to participate [26]. Participation in the workshop was fully funded, covering accommodation, meals, and all fees, with travel grants provided to all applicants who requested support, ensuring that financial constraints were not a barrier to access. We are incredibly grateful that the funding agency allocated a budget for on-site childcare, as 12% of the applicants expressed interest in using such on-site support, and two of the participants used this option.

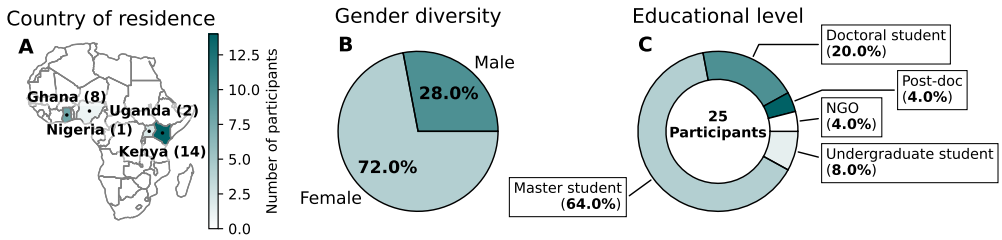

Fig 2. Participant distribution by country, gender, and education level in Case Study 1. A) Countries of residency of the 25 Sub-Saharan participants are marked on the map. The countries' colors reflect the number of participants. B) The participants' gender distribution. C) The educational level of the participants at the time of the hackathon. Participants stemmed from African universities or Non-Governmental organizations (NGOs).

Environmental Hackathon with real data

The Summer School culminated in a **25-hour** hackathon focused on improving marine conservation in Watamu. Participants analyzed a three-year subset of **real-world data** on sea turtles accidentally caught by fishermen in the Watamu region. This dataset, collected over the past twenty years by the Local Ocean Conservation (LOC)[a] organization, provided valuable insights into bycatch patterns and conservation challenges. The dataset included information on fishing methods, turtle health, and recovery times. To maximize productivity, participants were divided into four groups, ensuring diversity in i) scientific expertise, ii) career stage, iii) geographic background, and iv) institutional affiliation to enrich data analysis. The workflow combined individual efforts with **plenary sessions** to foster collaboration, ensure coherence, and minimize overlap in tasks. Throughout the hackathon, **six trainers** were readily available to provide guidance and support, ensuring smooth progress and effective learning. The first day focused on generating insights from the data, where participants had identified key insights, including human threats to sea turtles and the most common by-catch methods and areas. The findings from day one were to be shared with the Watamu fishermen on the second afternoon. Since the presentation had to be in the local native language, Kiswahili, and without electronical aids, the morning was dedicated to preparing the and documenting the findings on flip-charts. In the afternoon, they presented their findings to the fishermen who had assisted with data collection and turtle rescue, providing translations of the exchange for their trainers. The presentations were well received, sparking meaningful discussion and mutual respect between the participants and the community. By emphasizing the relevance of data collected by the fishermen the participants could encourage them to continue the conservation efforts. This hackathon achieved its goals by building participants' confidence in their newly acquired skills, fostering connections between the Summer School and the local community, and providing valuable feedback on the community's conservation work.

[a] `https://localocean.co/`

Case study 2: Hackathon Workshop 2023, Embu, Kenya

In September 2023 we implemented a similar concept of **hacking for education** during a workshop at the University of Embu, Kenya. University students from all across Africa could apply online to participate, facilitating international exchange. 23 students with a background in mathematics, statistics and life sciences were selected for the workshop. In a shorter format, spanning only five days (Supplement Fig. S2, the

students learned Python for data analysis and mathematical modeling, focusing on epidemiology, particularly HIV, and algal blooms. These topics were chosen due to their significant relevance in regions like Kenya, where HIV remains a pressing health issue, as previously effective control measures are not being widely adopted by the youth [27]. Additionally, the prevalence of algal blooms in bodies of water such as Lake Victoria has led to environmental and public health concerns, including the contamination of drinking water and negative impacts on local fisheries [28]. Lectures and hands-on programming sessions allowed students to visualize and solidify concepts, with facilitators on hand for support. Throughout, the theory was directly employed in practical programming sessions, allowing the students to contextualize their skills, further improving their understanding. While the main trainer led the class, the facilitators moved among the students, addressing both technical and non-technical questions, troubleshooting challenges as they arose, and ensuring no student was left behind.

Epidemiological Hackathon with generic data

The five-day workshop concluded with a **14-hour hackathon**, during which 23 students applied their skills to develop predictive tools aimed at addressing two distinct challenges: the spread of HIV and the occurrence of algal blooms (Fig 3). The choice of these diverse topics was deliberate, reflecting our aim to demonstrate that, despite their differences, both challenges rely on similar mathematical frameworks—specifically, ordinary differential equations (ODEs)—and share comparable development processes. Both algal blooms and infectious diseases spread in environments where conditions are favorable, such as nutrient-rich waters for algae or high-contact populations for diseases. The students were split into four working groups and given one of the two datasets on HIV-infected T-cells or phytoplankton growth. This setup allowed each dataset to be approached from different analytical perspectives, fostering diverse perspectives and strategies for analysis. Within a long evening and an early morning session, the students began by exploring the data, using statistical methods to identify patterns, trends, and potential outliers. This initial analysis helped them gain a deeper understanding of the underlying biological processes and set the stage for more complex modeling. After completing the data analysis, the groups proceeded to build coarse-grained mathematical models based on their findings. For the HIV-infected T-cells dataset, the models aimed to simulate viral dynamics and immune responses, while the phytoplankton groups focused on modeling factors influencing growth rates, such as nutrient availability and light exposure. Throughout the process, the groups used iterative approaches to refine their models, incorporating feedback from facilitators and peers. The hackathon concluded with students presenting their findings to an audience comprising their peers, university staff, and the vice-chancellor. This high-stakes setting added significance to the experience, underscored the importance of their efforts and greatly enhanced the students' motivation, as the prospect of presenting to such a distinguished group pushed them to refine their understanding and clearly articulate their findings. The recognition and constructive feedback from both peers and university staff provided further encouragement, motivating them to pursue future interdisciplinary research with greater enthusiasm and self-assurance. The satisfaction poll conducted among all participants was uniformly positive (Fig 4A, B & C). The students' takeaways ranged from programming skills to project conceptualisation, also depending on their previous experiences with hackathons (Fig 4D). A majority of participants supported the idea of introducing hackathons in their general curriculum (Fig 4B). The general experience of the students is well summarised by the following statement of one of the participants *"This will definitely be a game changer. In our out of workshop discussions with my colleagues we all agreed that what we gained is what a normal student will gain in a whole semester."*

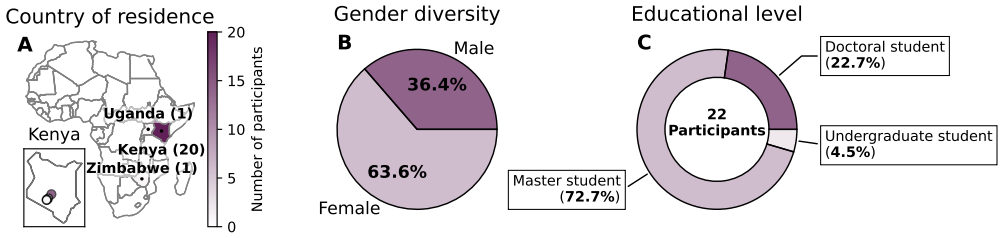

Fig 3. Participant distribution by country, gender, and education level in Case Study 2. A) Countries of residency of the 23 participants are marked on the map. The countries' colors reflect the number of participants. The inset plot shows the location of the participants' Kenyian universities. B) The participants' gender distribution. C) The educational level of the participants at the time of the hackathon.

Discussion

Hackathons are intense, time-bound events in which participants collaboratively solve problems, often involving programming, engineering, or data analysis. In an educational context, hackathons provide a unique blend of project-based, authentic learning, teamwork, and real-world problem-solving, thereby promoting active learning over passive absorption. By solving complex problems, students further improve critical thinking, coding, engineering, and project management skills. Based on our experience, this approach enhances learning by fostering deep engagement, skill development, and readiness for professional challenges in a life sciences context, expanding the supportive body of evidence— primarily focused on software and engineering students [18, 29, 30]— to **biological education**.

The collaborative nature of hackathons encourages teamwork and communication. Due to the growing integration of computational, mathematical, and engineering approaches with traditional biological sciences, these are essential skills to solve modern biology problems. We could observe this in our workshops, as the students exhibited increased motivation when confronted with practical applications that required knowledge from each of their respective backgrounds. That underscored the importance of interlinking STEM fields, which in turn nurtured a more profound interest in exploring approaches from other scientific disciplines. Finally, by leveraging AI for routine tasks such as coding assistance or data analysis, participants can devote more effort to critical thinking, experimental design, and innovative problem-solving, fostering a deeper understanding of scientific challenges.

We carefully created an environment that empowered students to seek help, which was crucial in the intense setting. This was further supported by team-building activities that allowed students to connect with their peers. In both cases, we could obverse this interaction extending beyond the end of the workshop, with the participants already acting as a network of collaborators. This, and the personalized support from facilitators, keeping ratio of max. four students per trainer, helped them overcome challenges and build confidence. For that, having more "helping hands" in the room played a pivotal role in "not leaving anyone behind" by providing continuous technical support to students. This helped us ensure that everyone would take home valuable skills from the Summer School and helped consolidate a collaborative interaction among the participants. This in turn helped to transform stress into an opportunity for growth.

Together, these elements prepare students for real-world challenges, cultivating a dynamic and inclusive educational environment that equips them with the most essential skills of the 21st century and hence prepares them for success in the modern workforce. The experience of these events indicated that the group challenge can be a

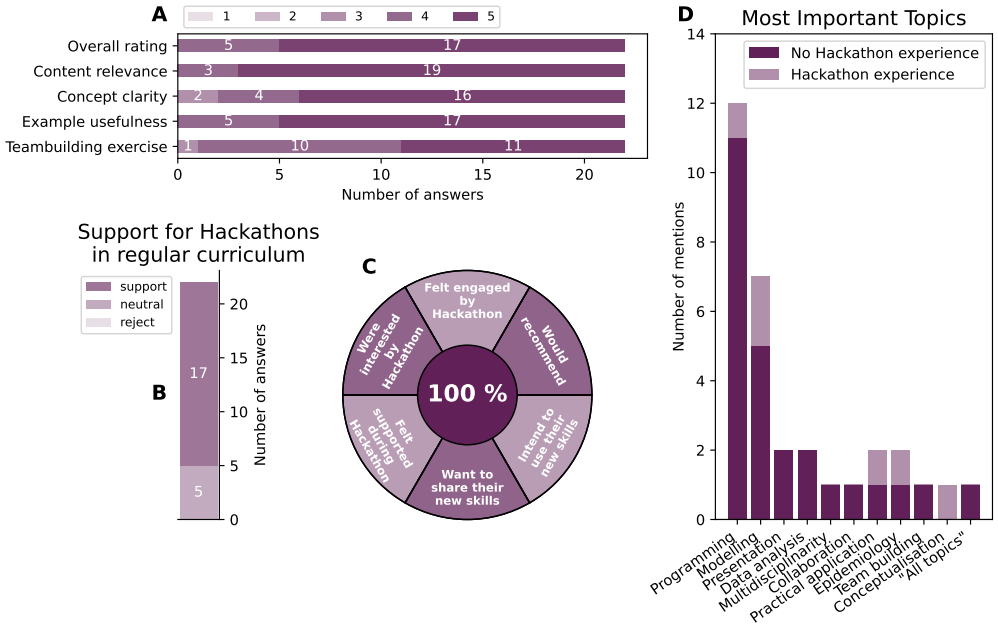

Fig 4. Participants' evaluation results of Case Study 2. A) Participants' rating of the hackathon-style workshop on a scale of 1 (worst) to 5 (best). B) Participants' response to having Hackathons included in their regular curriculum. Answers with no clear position were counted as "neutral". C) Summary of binary questions to the participants that were uniformly answered with "Yes." D) The most participants' important topics in the workshop, separated by whether they had previously participated in a hackathon. The participants' free text answers were assigned all common topics explicitly mentioned. Figure D shows the number of mentions of each topic across participants. Results in B and D stem from free text (see Tables S2.

great motivator and an empowering tool. To make this more feasible, hackathons could be integrated into regular curricula by adjusting the scale and structure to fit the available resources. Recently, it has been reported that integrating a hackathon into a software development and architecture course is benefitial for student performance and knowledge retention [31]. For example, in a school or university setting, the mentor-to-participant ratio could be adjusted by involving older students or advanced learners as mentors. This approach would not only provide valuable guidance to participants but also allow experienced students to develop leadership and communication skills. Additionally, hackathons could be incorporated into ongoing courses, with smaller, more manageable projects that build over time, rather than relying solely on large, one-off events. By integrating hackathons as a recurring part of the learning process, they can serve as an accessible and effective tool for developing essential skills in teamwork, problem-solving, and interdisciplinary collaboration. In turn, strengthening such collaboration may help mitigate concerns that contemporary research lacks imagination and offers little new theoretical insight.

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KNOWLEDGE FOR TOMORROW –
COOPERATIVE RESEARCH PROJECTS IN SUB-SAHARAN AFRICA

Kenya 2022
Summer School
in Computational Biology
for Sustainable Environment

Program

Summer School in "Computational Biology for Sustainable Environmental Research"

WEEK 1

		Mo 5.09	Tue 6.09	Wed 7.09	Thu 8.09	Fr 9.09	Sa 10.09	Su 11.09
Morning Sessions	8:00 - 09:30	Arrival	Different facades of computational Biology	Intro to Python: numpy & pandas	Working with data sets using pandas	Intro to modelbase Building mathematical models	Field trip to the Conservation Sites	Day Off
	Coffee break							
	10:00 - 11:30		Intro to Python: syntax & semantic	Intro to Python: numpy & pandas	Working with data sets using pandas	Modelling population dynamics		
Mid daybreak 11:30 - 14:30								
Afternoon practical	14:30 - 16:00	**Opening session** Mission & Short-term goals **Keynote**	Intro to Python: syntax & semantic 1	Intro to Python: numpy & pandas	Introduction to mathematical modelling (ODE)	Zoology and Fishery		
	Coffee break							
	16:30 - 18:00/19:00	**Kick-Off Social Event*** with Poster Session** Get to know for participants. Everyone is presenting their science to each other	Intro to Python: syntax & semantic 2	Discussion: What is sustainability?		Modelling population dynamics		

WEEK 2

		Mon 12.09	Tue 13.09	Wed 14.09	Thu 15.09	Fr 16.09
Morning Sessions	8:00 - 09:30	Intro to the R Project for Statistical Computing	Data Opportunities in Local Organisations	Hackathon with real biological and environmental data provided by the Local Ocean Conservation Group	Hackathon	Closing remarks combined with the field class at the Snake Farm
	Coffee break					
	10:00 - 11:30	Load, Clean and Manipulate with Data in R	Explorative Data Analysis and Statistical Models in R		Preparing final presentation	
Mid daybreak 11:30 - 14:30						
Afternoon practical	14:30 - 16:00	Explore your Data with Visualizations in R	Explorative Data Analysis and Statistical Models in R		Final Outreach Activity Presentation to the local Community	
	Coffee break					
	16:30 - 18:00/19:00	Explorative Data Analysis and Statistical Models in R	What is a Hackathon? Preparation for the event			

LECTURES INTERACTIVE COMPUTATIONAL SESSIONS INTERACTIVE SESSIONS

Fig S1. Case Study 1: Comprehensive Program Schedule for the Summer School in 2022, detailing the sequence of sessions, topics covered, and key activities designed to enhance participants' learning experiences, including a 25-hours hackathon.

2023 Hackathon Workshop on Computational Modeling to Unleash the Computational Power of Young African Researchers						
		MONDAY 21/08/2023	TUESDAY 22/08/2023	WEDNESDAY 23/08/2023	THURSDAY 24/08/2023	FRIDAY 25/08/2023
Morning Sessions	8:00 - 9:00	Registration and Welcome	**Foundations of dynamic modeling**	**Better Graphs** Practical tips to improve the data visualizations you are working on	Registration to the Public Event	**Open Hackathon Session**
	9:00 - 10:30	**Opening session** Mission & Short-term goals **Keynote**	**Intro to Data Visualization**	**Intro to building mathematical models** and efficient use of on-line resources	**PUBLIC LECTURE** **Collaborative Research to Maximize the Potential of Data-Driven Approaches in Interdisciplinary Breakthroughs.**	
	Coffee Break					
	11:00 - 13:00	**Public Health, Epidemiology, and Models**	**Data Visualization with Pandas**	**Modelling Population Dynamics**		
Afternoon practical	13:00 - 14:00	Lunch Break				
	14:00 - 16:00	**Introduction to Computational Biology and Modelling**	**Working with real-world data sets**	**Modelling Population Dynamics**	**Open Hackathon Session**	**Discussion Future of Computational Biology: Data Science and AI**
	Tea Break					Tea Break
	16:30 - 18:00	**Introduction to programming with Python**	Social Event	**Model Fitting to Data**		Closing dinner

LECTURES INTERACTIVE COMPUTATIONAL SESSIONS INTERACTIVE SESSIONS

Fig S2. Case Study 2: Comprehensive Program Schedule for the Hackathon Workshop in 2023, detailing the sequence of sessions, topics covered, and key activities designed to enhance participants' learning experiences, including a 14-hours hackathon.

Table S2. Summary of the open answer of the survey distributed among participants of the Case Study 2. Participants' answers to the question "*After participating in this hackathon-style workshop, what are your opinions on incorporating the hackathon teaching approach into your undergraduate or postgraduate curriculum? This approach involves multiple instructors in a classroom setting, with hands-on practical activities following the introduction of each concept, including programming activities and group challenges to test the understanding of concepts and computational skills.*" The right column shows the interpreted support shown in Fig 4B. If an answer contained no explicit support for the incorporation of hackathons, it was counted as neutral.

Answer	Support
Incorporating multiple instructors	Neutral
I think that would be amazing. Most often than not we don't get this kind of training setup in our educational systems. It would be a different experience for students and would encourage practical learning. I wish I had this kind of exposure earlier on in my career.	Support
The strategy should be implemented since the student will learn many skills.	Support
It brings out the best in individuals.	Support
I wish we stop just talking and applying it. It is the best way. I am using it now. I wish I went through such a system	Support
I guess incorporating this teaching approach would likely require careful planning and resources, though it definitely has the potential to significantly enhance the quality of education for students, particularly in fields that involve computational and practical skills and this would better prepare students for the demands of the modern workforce. It aligns well with the goal of producing graduates who are not just knowledgeable but also skilled and adaptable problem solvers. So, I believe.	Support
Yes will incorporate coding	Support
THE STYLE ENGAGES EVERYONE UNLIKE THE NORMAL CLASS SET UP	Support
The skills and experience gained am going to apply them in my research since they are relevant and useful	Neutral
Grouping learners is very important Knowledge in programming was very useful	Support
Undergraduates and postgraduates To be taught these skills	Neutral
I believe that incorporating the hackathon teaching approach into our curriculum would not only enhance our academic experience but also prepare us better for real-world challenges. It promotes active learning, critical thinking, and practical skills development, making it a valuable addition to our education.	Support
It is a good concept as people are more likely not to forget what they learn with a friend in a friendly setting	Support
Am up to it. It was a good experience.	Support
Bioinformatics and computational skills should be introduced in undergraduate curriculum	Neutral
yes it very effective	Support
It's a good teaching and learning approach	Support
I think the hackathon teaching approach can be a valuable addition to undergraduate or postgraduate curriculums. It can help students to learn in a more hands-on and collaborative way, and it can help them to develop the skills and knowledge they need to succeed in the workplace.	Support
I love the idea	Support
I think it's the best idea since the instructors will focus more on a learner as an individual	Support
This will definitely be a game changer. In our out of workshop discussions with my colleagues we all agreed that what we gained is what a normal student will gain in a whole semester. So imagine if the approach was used in postgraduate curriculum, then within a year we will definitely have a cure fir cancer, HIV and Covid-19. With do doubt I highly support that.	Support
Scientific python makes data analysis easier as compared to other mathematical softwares	Neutral