JUTLP
Journal of University Teaching & Learning Practice

Collaborative Design and Assessment of an Online, Asynchronous, Self-Paced Sustainability Course to Enhance the Capacity of Women Scientists

Narjis Fatima Hussain[a], Anil Khamis[b], and Farah Ahmed[c]
[a]University of Toronto, Canada; [b]Aga Khan University, Kenya; [c]Aga Khan University, Pakistan

Abstract

Women scientists in low- and middle-income countries continue to face gender-based barriers in accessing higher education, research training, professional development, and leadership opportunities, underscoring the responsibility of higher education institutions, particularly in the Global South, to actively support women's leadership and mentorship. While online and asynchronous learning environments have expanded globally, limited evidence exists on how Sustainable Development Goals (SDGs)-focused pedagogy can be designed to support women scientists in these contexts. This study examines the collaborative development and evaluation of an online, asynchronous, self-paced SDG course implemented within a broader capacity-strengthening initiative. Using the ADDIE instructional design model and a multidisciplinary co-design process, we analyse how online pedagogical strategies and EdTech tools shaped learner engagement, knowledge acquisition, and perceived relevance. Mixed-methods evaluation included pre-/post-testing, learning analytics of discussion forums, and Student Evaluation of Teaching (SET). Results demonstrate a 9.6% knowledge increase ($p<0.005$), high engagement across eight discussion boards, and a 68.8% completion rate – substantially higher than typical online learning benchmarks. Findings contribute to scholarship on education for sustainable development by illustrating how gender-responsive, contextually grounded online design can enhance SDG learning and foster communities of practice among women scientists in the Global South.

Editors

Section: Special Issues
Senior Editor: Dr Cassandra Colvin
Associate Editor: Dr Navneel Prasad
Guest Editor: Dr Chee Leong Lim

Publication

Received: 16 October 2024
Revised: 28 July 2025
Accepted: 1 December 2025
Online First: 24 February 2026
Published: 26 March 2026

Copyright

© by the authors, in its year of first publication. This publication is an open access publication under the Creative Commons Attribution CC BY-ND 4.0 license.

Keywords

Sustainable development goals, capacity building, women scientists, technologically-enhanced pedagogies, multidisciplinary cooperation.

Citation: Hussain, N. F., Khamis, A., Ahmed, F. (2026). Collaborative design and assessment of an online, asynchronous, self-paced sustainability course to enhance the capacity of women scientists. *Journal of University Teaching and Learning Practice, 23*(6). https://doi.org/10.53761/vah9my52

Introduction

Gender disparities in academia persist globally, but they are especially pronounced in low- and middle-income countries (LMICs), particularly in Africa and South Asia, where structural and institutional barriers continue to limit women's advancement in science (Fru, et al., 2021) (Morley & Crossouard, 2015) (Thelwall, Bailey, Makita, Sud, & Madalli, 2019). According to the *Women in Science 2020* report by UNESCO, women constitute less than 30% of the global research community, with the representation dropping as low as 19% in South and West Asia and 23.9% in East Asia and the Pacific (UNESCO Institute for Statistics, 2020). Despite growing global attention to equity in science, women in LMICs remain underrepresented in research leadership and scholarly publishing.

These inequities are not merely numerical but also deeply embedded in research capacity systems. Recent analyses indicate that women researchers, particularly in LMICs, face disproportionate challenges in accessing training, mentorship, research funding, and opportunities for international collaboration, all of which contribute to persistently lower scholarly output compared to their male counterparts (Shannon, et al., 2019). Gendered norms, caregiving responsibilities, limited institutional support, and socio-political constraints further exacerbate these disparities, particularly for women in early- and mid-career stages (Fru, et al., 2021).

Given these challenges, there is an urgent need to create inclusive, scalable platforms that address gendered barriers in academic development. Digital and online learning platforms offer one such opportunity. Over the past decade, massive open online courses (MOOCs) have expanded rapidly from 300,000 learners in 2011 to over 220 million by 2021, demonstrating the potential of online learning to reach underserved populations (Diaz-Infante et al., 2022). This growth has been further accelerated by the COVID-19 pandemic, which normalized virtual learning environments and highlighted their potential for democratizing access to education.

However, most online professional development and research capacity initiatives remain gender-neutral in design, rarely accounting for the specific barriers faced by women scientists in LMICs. Research suggests that tailored, gender-responsive training programs are more effective in improving outcomes for women, particularly when they are designed to accommodate diverse schedules, geographic isolation, and institutional limitations (Morley & Crossouard, 2015).

In response to these gaps, the Supporting Women in Science (SWIS) program was developed by the Aga Khan University's Institute for Global Health and Development in partnership with the University of Oxford (Das et al., 2024). SWIS is a capacity-strengthening initiative designed to support early- and mid-career women scientists from South-Central Asia and Sub-Saharan Africa. The program seeks to address gender inequities in research by providing tailored professional development opportunities, mentorship, and training that are both accessible and contextually relevant.

A core component of the SWIS program is a bespoke, asynchronous online course grounded in the principles of the Sustainable Development Goals (SDGs), with a particular focus on SDG 5 (Gender Equality), SDG 4 (Quality Education), and SDG 3 (Good Health and Well-being). The course was developed in response to expressed needs from female scientists in LMICs for

Citation: Hussain, N. F., Khamis, A., Ahmed, F. (2026). Collaborative design and assessment of an online, asynchronous, self-paced sustainability course to enhance the capacity of women scientists. *Journal of University Teaching and Learning Practice, 23*(6). https://doi.org/10.53761/vah9my52

flexible, relevant, and practical academic development opportunities that align with local and global health priorities.

However, there has been debate on how best to teach ‘education for sustainable development’, which raises the question of an appropriate ‘pedagogy’ (Ferrer-Estévez & Chalmeta, 2021). Most of the scholarly and Scholarship of Teaching and Learning (SoTL) research literature in these areas refers to physical, center-based practice. With the nudging to online and blended learning through the COVID-19 transition and greater interest in equity, this study considers appropriate pedagogy for online delivery of the SDGs.

Despite growing literature on online and blended learning, limited research examines how SDG-oriented pedagogy can be designed and implemented for women scientists in LMICs using gender-responsive and context-sensitive approaches. Existing studies on education for sustainable development largely reflect in-person or Global North settings, leaving important gaps in understanding how asynchronous online modalities can support equitable research capacity development. This study addresses this gap by analyzing the design, implementation, and outcomes of a collaboratively developed online SDG course. Specifically, it asks: How can multidisciplinary co-design and online pedagogy support meaningful engagement with SDGs among women scientists in LMICs, and what evidence emerges regarding learner outcomes? In doing so, the paper contributes to scholarship on SDG education, online learning design, and gender-responsive professional development, and highlights the value of the approach in advancing equitable research ecosystems in LMIC settings.

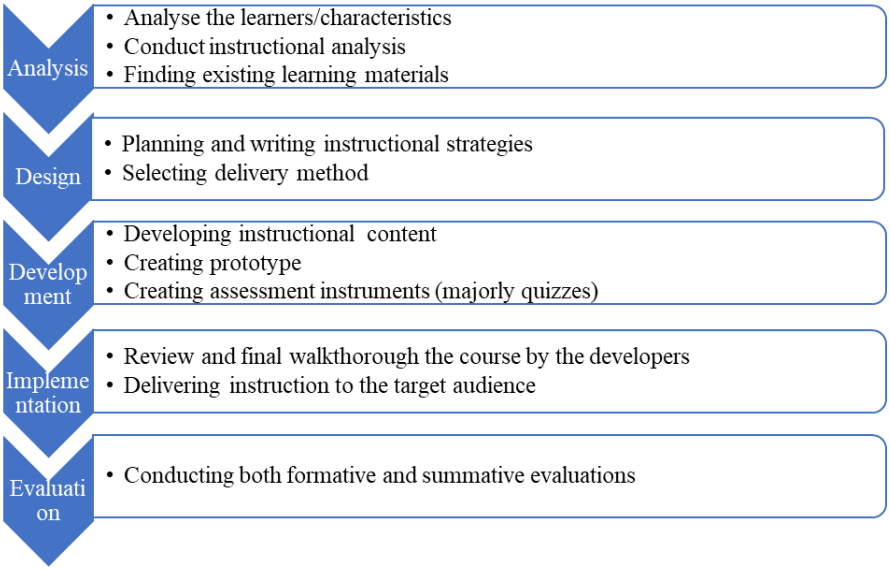
Method

The study adopts a design-based research orientation, drawing on the ADDIE instructional design model (Khalil & Elkhider, 2016) to examine both the development process and learner outcomes of the SDG course. Consistent with SoTL methodologies, the approach integrates iterative co-design, implementation, and evaluation to generate evidence on the pedagogical effectiveness of online SDG learning for women scientists in LMICs. Figure 1 describes the ADDIE model with the elements Analysis, Design, Development, Implementation, and Evaluation.

Analysis Phase

In the analysis phase, the context of the course and the learner characteristics were defined and established, conducting instructional analysis, and finding of the existing materials for the course. The Course Development Team (CDT) comprised of the subject matter experts, course administrator, educational technical expert, and educational specialist. The multidisciplinary team was instrumental in designing and delivering a course that catered to all aspects of the program and translated well into its learning objectives. The following questions were critical to this phase: Who is the audience and their characteristics? What type of learning constraints exist? What are the delivery options? What are the learning outcomes? What are the online pedagogical considerations? What is the timeline for project completion?

Figure 1: *The ADDIE Model*



The extensive discussions of the CDT were crucial in answering the questions and establishing a viable plan for the course during the analysis phase. The audience were defined as adult learners and professionals enrolled in the Women in Science program with time constraints. As such, the SDG course had to be designed for an asynchronous, self-paced delivery mode. With such a limited focus, we decided to use the AKU Virtual Learning Environment (VLE), a Moodle-based platform, developed to organize the student classrooms through virtual course modules and assessments. VLE also allows for asynchronous and self-paced course delivery and aligned well with our requirements.

Further, in line with adult learner characteristics or andragogy (Knowles, 1980) and that we expect the learners to be digital natives (Prensky, 2009) (Lozano-Diaz & Fernandez-Prados, 2020), the following general principles were considered in designing the online SDG course keeping in mind that the learners are based in the Global South: 1) Relevance: The course should be relevant to the students' interests and needs; 2) Flexibility: The course should be flexible enough to accommodate the students' schedules and learning styles; 3) Support: The students should have access to support from the course team and other learners; and 4) Assessment: The learners should be assessed in a way that is fair and that reflects their learning and particular circumstances. The following dominant pedagogical approaches to online and blended learning were included (Dean, Wright, & Forray, 2020): 1) Problem-Based Learning (PBL): A learner-centered approach to learning in which participants work in groups to solve real-world problems; 2) Research-Based Learning (RBL): An approach to learning in which learners conduct their own research to answer a question or solve a problem that is of particular interest to them or in their work/discipline area; 3) Flipped Learning: Involves learners watching lectures or reading materials outside of class, and then coming to class to work on activities, projects, or discussions related to the material; 4) Project-Based Learning: Involves learners working on long-term projects that require them to apply the concepts they are learning to real-world situations; 5) Experiential Learning: Involves learning through hands-on experience. Finally, the time of completion was

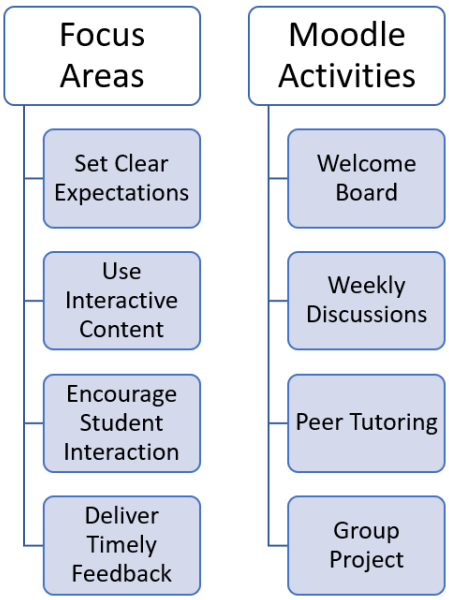
decided to be 50 hours for completion of all activities as well as to integrate the program well with Women in Science program timelines.

Design Phase

In the design phase, the format or plan of the course and the delivery of each module were discussed and determined. The course design template was established, based on the “Essentials of Online Course Design and Facilitation: Self Learning Manual" (Kevin & Naseem, 2021), and was instrumental in guiding the process. The SDG course is a six-module course with each module having module description, learning outcomes, activities, assessments, and relevant resources. Each module ends highlighting key points of the module and further readings.

The modules included: Introduction to Sustainable Development, History and Theoretical Backdrop, National Development Plans and Possibilities, Introduction to Climate Change and Action, Knowledge Generation Prospects – Learning from the Development Context, and Learning from the Community and Experts – Panel. It is also at this point that the VLE was set up and extensively discussed. We opted for a linear sequential approach where learners follow a predefined sequence of modules. Each module builds upon the knowledge and skills acquired in the previous one. This approach provides a structured learning experience and ensures that learners cover the content in a logical order.

Figure 2: *EdTech Strategies*



VLE features such as sequential release of modules, module prerequisites, and completion tracking allow learners to progress through the course in a linear manner, accessing modules one by one based on their completion status. In addition, we mobilized EdTech strategies for active participation learning through forum discussion boards which required mandatory subscription through creation of at least one post and replies to two posts as part of the linear sequence model. By employing these Edtech strategies, instructors can effectively design and deliver asynchronous online courses that cater to diverse learning preferences and promote meaningful

engagement. Figure 2 illustrates the strategies utilized. Finally, we also wanted to integrate course evaluation with the course delivery. For that purpose, we modified the Student Evaluations of Teaching (SET) form to conform to an online, asynchronous modality so that feedback can be utilized for course improvement.

Development Phase

Before this phase began, the multidisciplinary team convened to establish a modus operandi that would ensure diverse perspectives, needs, and approaches were integrated into the final product. The SWIS program manager led the programmatic aspects, ensuring that the course design and delivery aligned with the program's objectives and could be feasibly integrated into the SWIS curriculum. The content expert took responsibility for developing and sequencing the curriculum, as well as leading its evaluation to ensure alignment with SWIS goals. The EdTech expert collaborated closely with both the content and IT experts to enhance the overall learning experience. Meanwhile, the IT expert ensured that the interface and delivery were compatible with the technical infrastructure and met the requirements of SWIS. The team fostered open communication and adopted an iterative approach to developing materials, integrating their expertise through sustained collaboration.

This phase was characterized by the development of instructional content, script and prototype design, and the creation of assessments (primarily quizzes). Multiple videos were produced for each module. The Panopto software was used to develop and embed these videos into the virtual learning environment (VLE), allowing for smooth delivery through voice-over recordings via PowerPoint. The EdTech strategies outlined in the Design phase were also integrated within the VLE. Table 1 illustrates the course's linear, sequential process flow, in which each module becomes accessible only upon completion of the previous one. The completion of each module is determined by the completion of its corresponding activities. The matrix also highlights that not all activities are restricted by such sequencing. This structured and methodical approach is intended to support learner navigation and facilitate comprehension.

Table 1

Course Matrix – Linear Sequential Process Flow

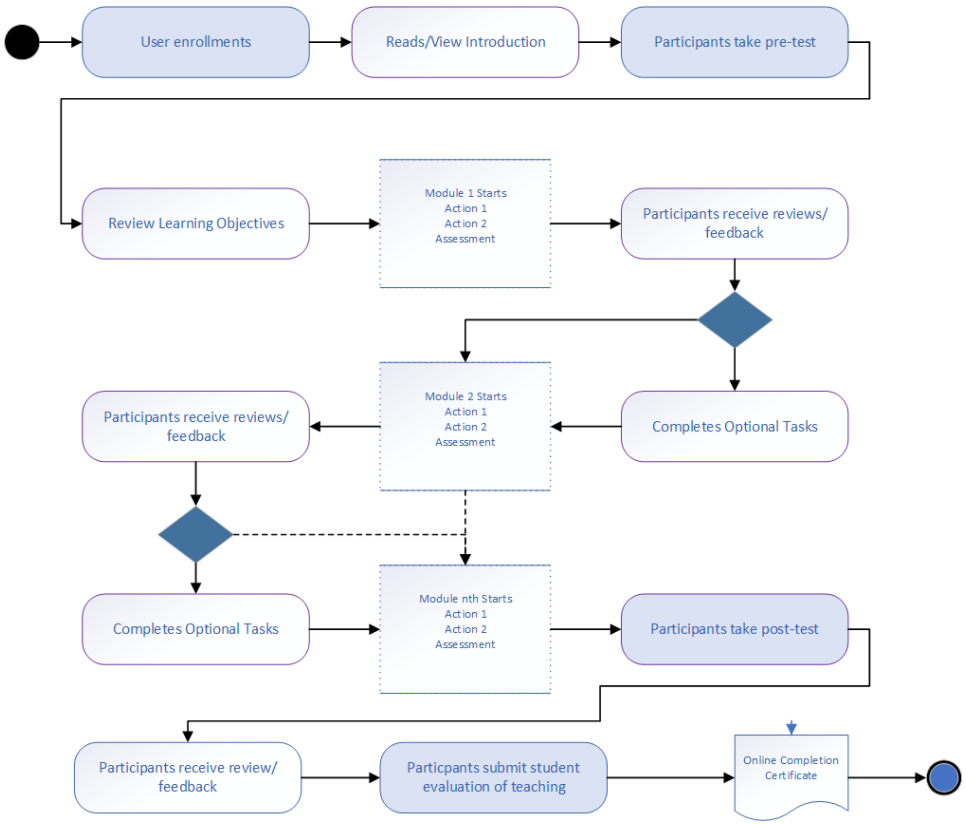
Module	Activity Completion	Restriction
1	Complete Activity 1	No restrictions - Course open since start date.
2	Complete Activity 2	Restricted until Module 1 specifically Assessments are completed.
3	Complete Activity 3	Restricted until Module 2 specifically Assessments are completed.
4	Complete Activity 4	Restricted until Module 3 and discussion forum are completed
5	Complete Activity 5	Restricted until Module 4 is completed.
6	Complete Activity 6	Restricted until Module 5 and Final Post Assessment Quiz are completed.
End	Complete SET form	Certificate issued upon evaluation form completion.

Implementation Phase

The implementation phase aligned with the Women in Science cohort enrollments. The participants were provided with a 6-month completion deadline from the time of enrollments as part of the eligibility for the next phase of the SWIS program. A course completion certificate (dependent on completion of all other activities as highlighted in the matrix – Table 1) was considered as evidence for course completion. The flow diagram in Figure 3 details the activities undertaken in the implementation phase:

Figure 3

Flow Diagram for Course Implementation



Evaluation Phase

The course evaluation employed multiple methods to gain a holistic understanding of both the process and the outcomes. To assess learning, we administered a pretest and posttest designed to measure knowledge gains across key concepts. A paired-sample t-test was conducted to determine whether the difference between pretest and posttest scores was statistically significant, thereby indicating the impact of the course on participants' knowledge acquisition.

To assess participant engagement, we analyzed metrics from the virtual learning environment (VLE), including posting frequency, replies, and views on discussion boards. Additionally, to

evaluate teaching effectiveness, document instructional development, and gather student feedback for course improvement, we implemented an anonymous and mandatory Student Evaluation of Teaching (SET) form. This encouraged open, honest responses and supported continuous course refinement.

Results

In April 2023, 186 participants were registered in the course as Cohort 2 of the program as a pilot launch and 180 more were enrolled in August 2023 as Cohort 3. However, for the purpose of this paper, we will focus on the results from Cohort 2 which completed in October 2023. These findings provide empirical evidence on learner engagement, course completion, and knowledge acquisition within an SDG-focused online learning environment.

Demographics

Women belonging to Cohort 2 were widespread across 8 countries: Pakistan, Kenya, Uganda, Afghanistan, Ethiopia, Nigeria, Tanzania, and Zambia. However, 61.2% belonged to Pakistan (n=112) and 25.1% were from Kenya (n=46). In terms of age, more than half (53.7%) were between 31-40 years of age while 27.4% were between 41-50 years. Only a small percentage of women were between 20-30 years (13.4%). As such, the mean age of the participants was 40 years across the cohort. Further, more than half (59.1%) of the participants belonged to public academic institutes with 64% identifying as teaching faculty, 47% as research faculty, and 19.5% as clinical faculty. Further details on educational exposure observed that 59.8% of the women had previous exposures to online learning platforms such as Coursera. Finally, in terms of learning preferences, 30.5% respondents expressed comfort with online learning while 61% preferred a combination of both, in-person and online learning modalities.

Retention and Engagement

From a total of 183 enrolled students in Cohort 2, 42 candidates did not initiate the program and were removed from the cohort. SWIS continued with 141 participants, of which a total of 97 women (68.8%) successfully completed the course within the required timelines. The course engagement was assessed based on discussion boards with the number of posts and replies. A total of 8 discussion boards were integrated across the course. Overall, across the 8 boards, the course recorded 1,057 posts and 1,684 replies, averaging 11 posts and 17 replies per participant. Table 2 summarizes the findings.

Excluding the pre-course discussion board, the most popular discussion forum in the course (408 posts and replies) aimed at creating conversations around SDGs, their importance and relevance locally and globally, and pathways to achieve. This was followed by the forum that encouraged discussion around partnerships in climate action especially in relation to gender equity (379 posts and replies). The least popular board centered around the National Development Plan (221 posts and replies), followed by the Arusha Programme (292 posts and replies) signifying that participant engagement was limited with structured topics and more fruitful with open-ended prompts that allowed for contextual knowledge exchange.

Table 2

Findings across Discussion Boards showcasing Engagement

S.No	Discussion Board	Posts	Replies	Total
1	Introduction to self and work impact (pre-course)	127	380	507
2	SDGs related to local and global context and achievement pathways	176	232	408
3	Theories and conceptual frameworks for SDGs	150	153	303
4	National Development Plan: priorities and gaps	102	119	221
5	Leadership on climate action and sectoral links	125	188	313
6	Partnerships in climate action especially in relation to gender equity	160	219	379
7	Arusha Programme – approaches towards multi-sectoral collaborations	102	190	292
8	Science and culture connections	115	203	318
Total across 8 discussion boards		**1,057**	**1,684**	**2,741**

Paired Sample T-test

A paired-sample t-test was run of pretest and posttest scores to ascertain the knowledge increase and if there was a significant difference in participant learning. In the pre- and final quiz, an average of 81.5% (±12%) and 90.0% (±14%) were observed respectively; t-tests show a significant increase in knowledge of 9.6% (p-value<0.005).

Student Evaluation of Teaching (SET)

The SET evaluation was based on two parts: the course team and the course itself. Items inquiring about the course team were graded on a Likert scale ranging from “Hardly ever” to “Always” while items for the course ranged from “Not at all” to “Agree completely”. Overall, participants were highly satisfied with the course team. The majority of the respondents (79%) agreed that the course team was always available, accessible and responsive and that they provided opportunities for collaboration with other students (76%) and encouraged participation and discussion (84%). Further, most of the students (74%) agreed that the team’s feedback was prompt and improved participation and performance. Similarly, many participants (78%) agreed that that course team provided a detailed course outline and shared the completion and progression criteria prior to commencement. Finally, 89% of the women agreed that the course team used a variety of learning activities that were essential for engagement. Table 3 summarizes the results.

For the course itself, 68% agreed that the course provided with a deeper understanding of the concepts and subject matter and 73% attested that the course quizzes and knowledge checks provided opportunity to demonstrate an understanding of the course material. Further, 64% of the participants reported that the course learning outcomes were met completely, while 34% mostly agreed with the statement. Additionally, more than half of the participants agreed that the course components improved understanding (70%), provided opportunity to draw from scholarly research (64%), allowed for critical reflection (66%), facilitated interaction with others and promoted creativity (66%) and was intellectually stimulating (65%). Overall, 100% of the students agreed that they would recommend the course to a peer. Table 4 summarizes the results.

Table 3

SET Responses for Course Team

Items	Responses (%)			
	Hardly ever	**Some-times**	**Frequently**	**Always**
The course team was available and accessible when I needed either through email or other means and was responsive.	0	2	19	79
The course team provided opportunities for me to collaborate/communicate with other students.	0	6	18	76
The course team encouraged participation and provided opportunity for discussion.	0	4	22	84
The course team's feedback and guidance on any issues shared with them was prompt and allowed me to improve my course participation and performance.	0	6	20	74
The course team provided a detailed course outline at the beginning of the course and organized course concepts and content in a logical manner.	0	6	16	78
The course team shared the course completion and progression criteria with us at the beginning of the course.	1	4	18	78
The course team used a variety of learning activities (e.g., discussions, videos, guest lectures, readings) that engaged me and met my own learning needs.	0	0	11	89

Further, when asked about the core competencies regarding the course, 90% of the students recorded that it increased their critical thinking skills, 64% associated it with life-long learning, and 63% highlighted that it targeted their problem-solving capabilities. Table 5 shows further details.

Table 4

SET Responses for the Course

Items	Responses (%)			
	Not at all	Some-what	Mostly agree	Agree
The course provided me with a deeper understanding of the concepts and subject matter.	0	1	31	68
The course quizzes and knowledge checks provided opportunity for me to demonstrate an understanding of the course material.	0	1	26	73
The course learning outcomes were met.	0	1	35	64
The course's "learning from expert(s)" component improved my understanding of the course material.	0	3	27	70
The course provided opportunity to draw from scholarly research.	0	4	32	64
Adequate support (e.g., educational technology and troubleshooting) was available and accessible to enhance my learning.	2	10	26	62
Course concepts were clearly presented.	0	2	34	64
The course provided opportunity for me to critically reflect on practice or on important issues in the subject matter.	0	3	31	66
Course discussions and opportunity to interact with other course participants provided opportunity for creativity and innovative thinking.	0	6	28	66
I found the course intellectually stimulating and motivating.	0	5	30	65

Finally, the SET analysis also noted that the course was well-organized, relevant, informative, and allowed for knowledge sharing. However, participants expressed the need for written/downloadable materials, more case studies especially from Africa, and inclusion of samples of multi-disciplinary research and collaboration to understand the process and implementation of such programs.

Table 5

Core Competencies of the Course

Problem Solving	Critical Thinking	Life-long Learning	Leadership	Ethical Reasoning	Effective Communication
63%	90%	64%	50%	50%	55%

Discussion

It is evident that SWIS builds a community of practice and that the SDGs form a coherent framework of engagement for the concerns that participants face in a gendered, fast-paced knowledge industry that must confront the challenges of the Anthropocene Age (UNDP, 2020). To address these challenges, the course provided participants the opportunity to co-create via a structured online and blended pedagogical approach to delve into matters at three levels: the personal – to empower and create agency; the organizational – to support change management whilst bridging siloed disciplinary boundaries as well as supporting a nascent community of practice in the Global South; and at the country or regional level – to initial social action to activate social justice considerations covered in the course.

For program developers, it is necessary to articulate course learning outcomes, measure participant engagement, and ensure relevance. The VLE and online modalities unleash capacities to reach large numbers of participants in the Global South who have been disenfranchised. The evolving digital ecosystems further create networked communities that can traverse boundaries to promote common interests that are important to cohorts such as those in the SWIS program.

The course development learning illuminates the importance of (i) resources – material, technical, financial, and organizational that must come to bear beyond the traditional disciplinary, institutional, and geographical location and (ii) following up on participants progress during and after the course to meet desired outcomes. It is considered that as higher education faces further disruption from the COVID-19 pandemic that catalyzed a transition to online learning that educational structures, programs, and approaches will need to be rethought. The paper outlined how multidisciplinary teams can work via collaborative approaches to design and deliver courses that can create an impact. The success of the SDG course under the SWIS program can be studied via a few important aspects including course completion rate, engagement via discussion boards, knowledge gains, and student-based evaluations.

The course completion rate is significant as it reflects the proportion of students who successfully finish a course, indicating the effectiveness and engagement level of the educational program. A high completion rate often suggests that the course meets the needs of learners, while a low rate may indicate issues such as content relevance, difficulty, or delivery methods that need improvement. The average completion rate of online courses is between 5–15%, and for MOOCs, it is 3–6% only. (Vos, 2023) However, the SDG course under SWIS recorded an almost 70% completion rate which is a strong indicator of course performance and engagement. However, the high rates may also be attributable to the structure of the SWIS program. The program is designed to build the capacity of women scientists in the first 6 months of enrollment. The participants who successfully complete all courses are then eligible to sit for an exam where the top 20-30% of the candidates are selected for distant-learning, blended research fellowship with provision for research funding of up to USD 20,000.

As such, the SDG course was integrated into the core curriculum of the SWIS program and completion was a requirement to progress to the next phase. While this might explain the high completion rates, it is also important to note that such programs that offer theoretical knowledge via courses and then offer opportunities for practical application via research, can be critical in

building capacity and boosting engagement. In that, the innovative design of SWIS along with the multidisciplinary approach for the SDG constitute a recipe of success.

This is further reflected in the engagement via discussion boards. A recent study analyzed 415 courses spanning two semesters and concluded that student posts averaged 470 per course and that the average posts per students was 19.9 (Gasell, Lowenthal, Uribe-Florez, & Ching, 2022). In our course, we found that across 8 discussion boards, our participants averaged 28 posts (11 original posts and 17 replies). While the course completion might be attributable to the SWIS program structure, the high engagement in discussion boards is significant as it indicates active participation and interaction among learners, fostering a collaborative learning environment. This engagement promotes knowledge exchange, critical thinking, and a sense of community, enhancing the overall effectiveness of the educational experience. Further, our course design made it compulsory for the students to post one original discussion and 2 replies. As such, the higher average might be because of the initial push due to compulsory interaction, allowing students to build upon them and engage meaningfully as the course progressed.

Another aspect of course success is knowledge gain as it allows assessment of the extent to which learning outcomes are met. While we observed a significant increase in knowledge by 10%, we acknowledge that this does not completely reflect learning outcomes. The use of pretest-posttest evaluations represents an easy and feasible way of assessing knowledge change and can be considered as a proxy for student learning. Conceptual courses like SDGs should expand beyond objective evaluations. The original course design did include assessments based on assignments, presentations, and group work; however, they were opted out owing to the limitations of SWIS modality. Hence, a better outcome evaluation needs to be considered for future implementation and can guide further research.

Finally, our SET evaluation was also an important aspect as it allows us to chart the way forward. As the course approach was iterative, it will allow us to modify and enhance the content and learning experience via student feedback. We also plan on a qualitative assessment to create opportunities for co-creation. In this course, we also expect to create more pathways of progress with the use of micro credentials, multiple entry and exit points towards modularization, and developing modalities for greater participant engagement with real-world effect.

Taken together, these findings contribute to three strands of scholarship. First, they extend the literature on education for sustainable development by demonstrating how SDG-related learning can be effectively supported through asynchronous, self-paced design tailored to Global South contexts. Second, the study advances gender-responsive online pedagogy by showing how inclusive design choices, including linear sequencing, structured discussion prompts, and targeted feedback, can cultivate agency and community among women scientists. Third, it offers methodological insight into how design-based approaches can be applied within capacity-strengthening initiatives to generate actionable evidence for program improvement. These contributions highlight the value of integrating SDG pedagogy with gender equity goals, offering a scalable model for research training in LMIC settings.

Conclusion

By grounding SDG learning in collaborative design, adult learning theory, and online pedagogical principles, this study demonstrates a scalable model for context-responsive SDG education that can inform future research and practice in sustainable development pedagogy.

Programs like Women in Science are crucial to provide a platform for women scientists in the Global South to build their capacity and bridge the gender differentials in research, academia, and leadership. This strengthens the argument for utilizing the program to improve comprehension of the SDGs, specifically among the selected cohort of women in the Global South as their underrepresentation in academia and offered opportunities via systemic inequities is a well-documented issue. By enhancing their understanding of the SDGs, the program equips female scientists with a broader perspective on global challenges, fostering a sense of responsibility and empowerment. This empowerment, rooted in a deep understanding of the SDGs, positions them to take on more prominent roles in research and policymaking, thereby addressing gender disparities in academic leadership.

Moreover, the growth in SDG capability among female scientists not only supports their academic and professional development but also enhances their contributions to addressing global challenges through research and innovation. This increased capability can lead to more meaningful participation in interdisciplinary projects, grant opportunities, and collaborations, ultimately contributing to their ‘success’ in academia. By linking SDG understanding with professional growth, the program offers a pathway for female scientists to leverage their expertise in ways that align with both academic excellence and societal impact.

Acknowledgements

The authors want to acknowledge the Institute for Global Health and Development, Aga Khan University for the platform to launch the course via the Supporting Women in Science Program, funded by the Bill and Melinda Gates Foundation. The authors disclose that they have no actual or perceived conflicts of interest. The authors disclose that they have not received any funding for this manuscript beyond resourcing for academic time at their respective university. The authors have not used artificial intelligence in the ideation, design, or write-up of this research. The authors list the following CRediT contributions: **Hussain:** Conceptualization, Methodology, Data curation, Original draft preparation. **Khamis:** Conceptualization, Methodology, Writing – Reviewing and Editing, Supervision. **Ahmed:** Methodology, Software, Visualization, Validation.

References

Das, J. K., Raza, M., Padhani, Z. A., Hussain, N. F., Villar, J., Kennedy, S., & Bhutta, Z. A. (2024). Addressing inequities in research for early to mid-career women scientists in low- and middle-income countries: “Supporting Women in Science” programme. *Frontiers in Global Women’s Health, 5*, 1386809. https://doi.org/10.3389/fgwh.2024.1386809

Dean, K. L., Wright, S., & Forray, J. M. (2020). Experiential learning and the moral duty of business schools. *Academy of Management Learning and Education, 19(4),* 569–583. https://doi.org/10.5465/amle.2018.0335

Diaz-Infante, N., Lazar, M., Ram, S., & Ray, A. (2022, July 20). *Demand for online education is growing. Are providers ready?* Mckinsey.com; McKinsey & Company. https://www.mckinsey.com/industries/education/our-insights/demand-for-online-education-is-growing-are-providers-ready

Ferrer-Estévez, M., & Chalmeta, R. (2021). Integrating Sustainable Development Goals in educational institutions. *The International Journal of Management Education, 19(2)*, 100494. https://doi.org/10.1016/j.ijme.2021.100494

Fru, M. I. N., Oshomoji, A. O., Omosanya, K. O. L., Mosuro, G. O., Lawal, M. A., Ndukwe, O. S., Eugene, R. P., Oussou, A., Rapholo, M., & Eruteya, O. E. (2021). Stereotyping and bias towards female earth science students and faculty members in Africa. *Journal of African Earth Sciences (Oxford, England: 1994), 184(104375),* 104375. https://doi.org/10.1016/j.jafrearsci.2021.104375

Gasell, C., Lowenthal, P. R., Uribe-Flórez, L. J., & Ching, Y.-H. (2022). Interaction in asynchronous discussion boards: a campus-wide analysis to better understand regular and substantive interaction. *Education and Information Technologies, 27(3),* 3421–3445. https://doi.org/10.1007/s10639-021-10745-3

Kevin, P., & Naseem, A. (2021, February 25). *Essentials of Online Course Design and Facilitation: A Self Learning Manual.* Aga Khan University. https://www.aku.edu/qtl/resources/Documents/bdl-manual.pdf

Khalil, M. K., & Elkhider, I. A. (2016). Applying learning theories and instructional design models for effective instruction. *Advances in Physiology Education, 40(2),* 147–156. https://doi.org/10.1152/advan.00138.2015

Knowles, M. S. (1980). The modern practice of adult education: From pedagogy to andragogy. *Cambridge Adult Education.*

Lozano-Díaz, A., & Fernández-Prados, J. S. (2020). Educating digital citizens: An opportunity to critical and activist perspective of Sustainable Development Goals. *Sustainability, 12(18)*, 7260. https://doi.org/10.3390/su12187260

Morley, L., & Crossouard, B. (2015). *Women in Higher Education Leadership in South Asia: Rejection, Refusal, Reluctance, Revisioning.* British Council. https://www.britishcouncil.pk/sites/default/files/women_in_higher_education_leadership_in_south_asia_-_rejection_refusal_reluctance_revisioning.pdf

Prensky, M. (2009). H. Sapiens Digital: From Digital Immigrants and Digital Natives to Digital Wisdom. *Innovate: Journal of Online Education (North Miami Beach, Fla.), 5(3)*, 1. https://www.learntechlib.org/p/104264/

Shannon, G., Jansen, M., Williams, K., Cáceres, C., Motta, A., Odhiambo, A., Eleveld, A., & Mannell, J. (2019). Gender equality in science, medicine, and global health: where are we at and why does it matter? *Lancet, 393*(10171), 560–569. https://doi.org/10.1016/S0140-6736(18)33135-0

Thelwall, M., Bailey, C., Makita, M., Sud, P., & Madalli, D. P. (2019). Gender and research publishing in India: Uniformly high inequality? *Journal of Informetrics, 13(1)*, 118–131. https://doi.org/10.1016/j.joi.2018.12.003

UNDP. (2020). *Human Development Report.* United Nations Development Programme. https://hdr.undp.org/content/human-development-report-2020

UNESCO Institute for Statistics. (2020). *Women in Science*. United Nations Educational, Scientific and Cultural Organization. https://uis.unesco.org/en/topic/women-science

Vos, L. J. (2023, May 8). *7 steps to boost your online course completion rates*. eLearning Industry. https://elearningindustry.com/steps-to-boost-your-online-course-completion-rates