CABI WORKING PAPER 37

CABI

CABI Academy Evaluation 2022

Authors
Sarah Fleming
Manju Thakur
Hideo Ishii-Adajar

November 2025

Credit: Petr Kosina/CIMMYT

KNOWLEDGE FOR LIFE

This CABI working paper has been internally peer-reviewed. It may be referred to as:

Fleming, S., Thakur, M. and Ishii-Adajar, H. (2025) CABI Academy Evaluation 2022. *CABI Working Paper* 37, iii + 57 pp. DOI: https://dx.doi.org/10.1079/CABICOMM-62-8195 (Originally issued November 2025, corrected version issued December 2025)

Sarah Fleming, CABI, Nosworthy Way, Wallingford, OX10 8DE, UK.
Email: S.Fleming@cabi.org; ORCID: 0000-0002-1380-6383

Manju Thakur, CABI India, 2nd Floor, CG Block, NASC Complex, DP Shastri Marg, New Delhi - 110012, India.
Email: M.Thakur@cabi.org

Hideo Ishii-Adajar, CABI, Silwood Park, Buckhurst Road, Ascot, Berkshire SL5 7TA, UK.
Email: h.ishii-adajar@cabi.org; ORCID: 0000-0001-6611-7285

Front page photo: Advisors at a plant clinic in Rufunsa district, Zambia. © David Ng'ambi for CABI.

Table of Contents

Abstract

This working paper evaluates two digital learning products offered by the CABI Academy since 2020: Crop Pest Diagnosis (CPD) and Crop Pest Management (CPM). The evaluation is based on data from in-course analytics, user surveys, key informant interviews, and focus group discussions conducted in Bangladesh, Rwanda, and Bolivia. Using an eight-tier evaluation model, the study assessed the effectiveness of learning transfer from these digital training activities.

Key findings highlight several barriers to course completion, including time limitations, language challenges, connectivity issues, and access to technology. In-person promotional and face-to-face orientation activities were found to increase learner enrolments significantly. Analytics also indicated that the courses have successfully reached the intended demographic, particularly in low and lower-middle income countries. Engagement data revealed that while learners are highly interested in core course content, their engagement tends to decrease as they progress through the modules. However, despite finding the assessments challenging, many learners attempt them multiple times to earn a certificate.

Based on this feedback, improvements have been made to course activities and assessments to enhance course usability and reliability. The courses primarily attract extension workers and students, suggesting a need for targeted promotional efforts to reach other stakeholders such as agri-business professionals. Key informant interviews suggest that learners value the course content, which has influenced their professional practices. However, more research is needed to evaluate the broader impact of knowledge dissemination to communities and smallholder farmers.

This report concludes with recommendations for future course evaluations and long-term platform improvements for CABI Academy.

Acronyms and abbreviations

CPD	Crop Pest Diagnosis
CPM	Crop Pest Management
FGD	Focus Group Discussion
GA	Google Analytics
IPM	Integrated Pest Management
KII	Key Informant Interview
L-TEM	Learning Transfer Evaluation Model
MOOC	Massive Open Online Courses
SME	Subject Matter Expert

List of tables and figures

Introduction

Background

Building on the work of the CABI-led global Plantwise Programme (2011–2020) (CABI, 2022), which has since evolved into the PlantwisePlus programme (2020–ongoing)[1], the PlantwisePlus team recognized the need to develop a range of digital tools to help improve the incomes and livelihoods of smallholder farmers by reducing crop loss and improving yields and quality. A key component of this digital offering includes strengthening farmer advisory services, which led to the creation of the **CABI Academy**: a global platform for training, education, and professional certification. Since 2020, the CABI Academy has hosted two self-study, online learning courses and their associated certification assessments: **Crop Pest Diagnosis** (CPD) and **Crop Pest Management** (CPM). These courses are designed to strengthen the skills of participating learners in the diagnosis and management of crop pest insects and diseases.

The CPD and CPM courses were adapted from the Modules 1 and 2 ("Field Diagnosis and Plant Clinic Operation" and "Giving Good Advice") of the ongoing, in-person, plant doctor training developed under the Plantwise programme. These modules were initially built into an e-learning package for training diagnostic skills, branded as PestSmart (CABI, 2018). Building on the success of PestSmart, the content was further redeveloped into a self-study online format to broaden access to this foundational knowledge beyond traditional face-to-face sessions, potentially supporting the scaling of plant doctor expertise. This digital approach offers practical, skills-oriented agricultural learning for a wide user base and enables the scaling of plant doctor training to strengthen extension services across more countries, while also serving as a resource for diverse stakeholders in crop health management, especially agricultural extension workers and agri-input suppliers who frequently advise farmers.

When the CPM course was initially launched in 2021, access was only limited to learners from countries participating in the Plantwise Programme (CABI, 2022). Meanwhile, access to the CPD course was limited to member countries that paid a subscription fee. However, between 2020 and 2021, both courses were experimentally rolled out as open-access resources for three-month trial periods. During these trials, the course content was made accessible in two ways: either freely available to partners in Plantwise countries or open to a broader audience, where the learning materials could be accessed at no cost, but a fee was required to download the certificate of completion. As of 2024, both courses are freely offered to 30 countries (CABI Academy, 2024) and an essential part of a wider suite of digital advisory tools offered by CABI (Ishii-Adajar *et al.*, 2024).

CABI Academy course structure

The CPD and CPM courses are hosted online using Moodle – a customisable, open-source learning platform[2]. They have been developed by Subject Matter Experts (SMEs), learning designers and editorial staff at CABI, and are now maintained by a dedicated Digital Learning Team at CABI which was established in 2022.

[1] Following the conclusion of its major funding, the successful Plantwise programme evolved into PlantwisePlus to support and integrate its most impactful elements as well as expand into new strategic areas consisting of more than 50 activities under 13 outputs. See for more information: https://www.cabi.org/projects/plantwiseplus/
[2] Moodle. https://moodle.org

Crop Pest Diagnosis

The CPD course is aimed at teachers and trainers, extension workers, agro-input dealers and agricultural students. The course aims to provide expert information and practice activities, enabling learners to identify crop pest symptoms and the potential causes of those symptoms in the field. It is a skills-based course, based on extensive practice activities and associated guidance.

Modules in this course include:

- Module 1: Symptoms
- Module 2: Insects and mites
- Module 3: Causes
- Module 4: Nutrient deficiencies
- Module 5: Diagnosis

Each module contains a series of lessons which typically include written instructional material for learners to read, with associated knowledge check quizzes to develop diagnostic skills on a lesson-by-lesson basis. Once content pages have been accessed by users, pages are automatically marked as complete, enabling the learner to track their progress throughout the course. The number of page views are also tracked for evaluating learner progress.

Alongside the course materials, learners are encouraged to take the Foundation and Practitioner certification assessments. The Foundation level assessment aims to assess learners' ability to recall information from the course. It is expected that Foundation level learners are in the early stages of their career and work in an environment where they receive supervision in their role. Within CABI's Skills Framework for Agriculture[3], a competency framework developed by CABI for those working in the agriculture sector, Foundation certifications are mapped to levels 1–3 (out of a total of up to 7 levels).

The Practitioner level assessment assesses learners' ability to apply the knowledge gained from the course to real-world style scenarios. These learners are expected to be more experienced in their roles and work without supervision. These certifications are mapped to levels 4 and 5 of the Skills Framework. There are plans to create a third 'advanced' level assessment, which will be aimed at learners who are in leadership-related roles and will be mapped to levels 6 and 7 of the Skills Framework.

The Foundation assessment for the CPD course underwent a revision in early 2022 to ensure the questions included are fair and consistent as well as relevant and focused on core course content. The multiple-choice question format is used because they provide an objective, unbiased assessment (except for any biases inherent in the questions themselves), and because the assessments can be automatically marked by the computer, allowing for efficient scaling of services. Learners are provided with a selection of randomly allocated questions from defined, module-specific question banks. The approach includes banks of at least three times as many questions as learners require. As such, learners will be presented with a new set of 20 questions on subsequent attempts (although the random allocation means that learners may still receive questions that they have previously attempted).

The Practitioner assessment went live in June 2022. This approach aims to assess how confident learners are in applying information from the whole course to diagnose symptoms from a range of crop pests and diseases.

[3] Skills Framework for Agriculture. https://agricultureskills.org

Crop Pest Management

CPM is a companion course to CPD. The intention is for learners to participate in the CPD course first, developing skills in the diagnosis of symptoms. They are expected to then move on to the CPM course, focusing on the management of insects and diseases identified in the CPD course. Both courses share the same target audience, and are skills-based courses, with scenario activities built in throughout.

The eight core content modules include:

- Module 1: Introduction & Definitions
- Module 2: Economics
- Module 3: Bacteria
- Module 4: Oomycetes
- Module 5: Fungi
- Module 6: Insects & Mites
- Module 7: Viruses
- Module 8: Chemical Application & Restrictions

The associated Foundation and Practitioner assessments mirror the approach and objectives taken by the CPD course. The Practitioner level assessment for this course was released at the end of 2022 and has banks of questions that follow the same format as the end of module scenarios but with different content. As with the CPD Practitioner assessment, learners can familiarize themselves with the format of the assessment questions before attempting the assessment itself.

Online course delivery format

The delivery format of the CPD and CPM courses follows a similar format to massive open online courses (MOOCs). MOOCs are open access, short, often unfacilitated by a tutor, self-study, with low or no barriers to entry for learners (Milligan and Littlejohn, 2017). The CPD and CPM courses share some of these core MOOC characteristics:

- **Massive**: The courses currently have several thousand enrolled learners.
- **Open**: The courses are available for free in many low-income countries. CABI does sell access to those countries who can afford it. This commercial activity enables CABI to continue to improve and maintain the service.
- **Online**: The courses and assessments can be taken entirely online, but CABI has encountered examples where groups of learners take the courses together. This allows space for discussion and locally specific implementation of the ideas.
- **Course**: The courses are designed as carefully sequenced sets of activities with gradually increasing difficulty.

Following the MOOC format means that the courses can complement formal study and fit in with the learner's timescales and timetable. It can also provide a low-cost route to professional development by enabling learners to fill in gaps in their professional capabilities (Milligan and Littlejohn, 2017). Using this format for the CPD and CPM courses allows for drawing on evidence and literature around approaches to evaluation, as well as apply lessons learnt from MOOC-based studies that focus specifically on this educational delivery format. For example, the free, open and informal nature of MOOCs often means that they can encounter difficulties in retaining learners (Jordan, 2014). They are also found to predominantly attract learners from more developed, higher-income countries (Christensen *et al.*, 2013). Moreover, the recent COVID-19 pandemic has produced substantial literature on both the potential and the pitfalls for digital technologies to provide meaningful learning experiences from a distance (Paudel, 2021; World Bank, 2021). However, much of this research has focussed on high income countries (Betthäuser *et al.*, 2023; Zhao *et al.*, 2025). Since PlantwisePlus-funded CABI Academy courses are predominantly aimed at learners in low and low-middle income countries, this working paper offers new insight into the developing context by examining the impact of ongoing digital learning courses on users for plant health and pest management.

The purpose of this working paper is to evaluate the effectiveness of learning transfer[4] from the Crop Pest Diagnosis (CPD) and Crop Pest Management (CPM) courses. The evaluation is guided by an eight-tier model and is based on data from in-course analytics, user surveys, key informant interviews, and focus group discussions conducted in three target countries across Asia, Africa, and Latin America—specifically Bangladesh, Rwanda, and Bolivia. The next section details the approach, and the following section presents the findings. The conclusion summarizes key learning points and recommendations, and the final section suggests areas for future research. Annexes can be found at the end of the working paper.

[4] Learning transfer is the application of knowledge or skills gained in a learning environment to another context (Chen *et al.*, 2016).

Study approach

Objectives and framework

This evaluation report seeks to understand how the CPD and CPM courses have performed against an identified evaluation framework. The primary aims of the evaluation are to:

- Improve the quality of existing CABI Academy courses
- Develop better practices for the development of future courses
- Provide a clearer understanding of what level of impact the courses are having on end users

In planning this evaluation, short- and long-term benefits of the evaluation have been identified, as detailed in Table 1.

Table 1. Evaluation objectives: short- and long-term benefits.

Evaluation objectives	Course improvement	Organisational / programme level
Short- to medium-term benefits	• Able to make improvements over time in assessments and course design • Improve support systems for the users • Able to build a community of practice for the course	• Able to formalize the evaluation framework for use with all products • Able to analyse impact of demographics (gender, youth) on online learning to inform future data collection, to the extent possible with Google Analytics data (see section 'Data tools and sources' for more information) • Measure learners' skills, attitude and improvement in their professional practice in response to PlantwisePlus programme aims • Test and improve the evaluation framework • Test research questions for broader digital learning applicability
Long-term benefits	• Improve assessment quality from data analysis of questions completed by learners • Improve in-course activities through analysis of Moodle data and learner interviews	• Learn the impact of demographics on course uptake and completion to help focus marketing activities and improve engagement for marginalized groups • Improve course design methods • Design an evaluation framework that works for all products • Measure the impact on learners' skills, attitudes and practices in response to PlantwisePlus programme aims

Learning-Transfer Evaluation Model (L-TEM)

The Learning-Transfer Evaluation Model (L-TEM) by Thalheimer (2018) is selected as the most appropriate model to structure the evaluation of this report (see Annex 1 for the selection process of an evaluation framework). The model focuses on continued professional development and the application of real-world skills to wider communities and environments which align to the core aims of the CPD and CPM courses. Its robust approach also offers the ability to be replicated and scaled for the evaluation of future CABI Academy courses.

The L-TEM consists of eight tiers (Fig. 1). The tiers are colour-coded, with red indicating a low level of value attributed to the method of data in providing evidence of learning transfer (tiers 1 and 2), although they are still likely to hold value for other evaluation purposes. Yellow indicates mediocre methods for assessing learning transfer (tiers 3 and 4) and green indicates good or useful evaluation methods (tiers 5–8) (Thalheimer, 2018).

Tier		
8	Effects of Transfer	**Effects of Transfer: Including outcomes affecting (a) learners, (b) coworkers/ family/friends, (c) organization, (d) community, (e) society, and (f) the environs.** *CERTIFYING EFFECTS OF TRANSFER REQUIRES: Certification of transfer plus a rigorous method of assessing transfer's causal impact—including positive and negative effects.*
7	Transfer	**When learner uses what was learned to perform work tasks successfully— as clearly demonstrated through objective measures.** • Assisted Transfer—when performance is substantially prompted/supported. *ADEQUATE TO CERTIFY ASSISTED TRANSFER.* • Full Transfer—when learner demonstrates full agency in applying the learning. *ADEQUATE TO CERTIFY FULL TRANSFER.*
6	Task Competence	**Learner performs relevant realistic actions and decision making.** • Task Competence—during or right after learning event. *Not a fully adequate metric because learners may forget their task competencies.* • Remembered Task Competence—after several days or more. *ADEQUATE TO CERTIFY TASK COMPETENCE.* *NOTE: "Tasks" comprise both decision making and action taking. For example, a person learning to write poetry could decide to use metaphor, could act to use it, or could do both.*
5	Decision Making Competence	**Learner makes decisions given relevant realistic scenarios.** • Decision Making Competence—during or right after learning event. *Not a fully adequate metric because learners may forget decision making competencies.* • Remembered Decision Making Competence—after several days or more. *ADEQUATE TO CERTIFY DECISION MAKING COMPETENCE.*
4	Knowledge	**Learner answers questions about facts/terminology.** • Knowledge Recitation—during or right after learning event. *Usually inadequate because knowing terminology does not fully enable performance.* • Knowledge Retention—after several days or more. *Usually inadequate because remembering terminology does not fully enable performance.*
3	Learner Perceptions	**A. Learner is queried in a way that reveals insights related to learning effectiveness.** • Examples: Measures that target Learner Comprehension, Realistic Practice, Learner Motivation to Apply, After-Learning Support, etc. *Such measures can hint at outcomes but should be augmented with objective outcome measures.*
		B. Learner is queried in a way that does NOT reveal insights on learning effectiveness. • Examples: Measures that target Learner Satisfaction, Course Reputation, etc. *A metric inadequate to validate learning success—because such perceptions are not always related to learning results.*
2	Activity	**Learner engages in activities related to learning.** • Measures of Attention *A metric inadequate to validate learning success—because learners may pay attention but not learn.* • Measures of Interest *A metric inadequate to validate learning success—because learners may show interest but not learn.* • Measures of Participation *A metric inadequate to validate learning success—because learners may participate but not learn.*
1	Attendance	**Learner signs up, starts, attends, or completes a learning experience.** *A metric inadequate to validate learning success—because learners may attend but not learn.*

Fig. 1. Learning-Transfer Evaluation Model (L-TEM) by Thalheimer (2018).

Activities in the evaluation of the CPD and CPM courses have been organized around the structure of the L-TEM model, and data have been gathered based on answering the research questions identified at the outset of the evaluation. The activities have been organized as outlined and detailed in Annex 2.

Research questions

The research questions for this evaluation are defined in the context of the L-TEM model (Fig. 1). This ensures that the data collected and analysed are focused towards providing evidence that is relevant to the aims of the courses. The research questions we aim to answer in this report are listed below.

Tier 1: Attendance

- RQ1 What are the barriers to enrolment and course completion?
- RQ2 Have promotional activities led to an increase in learner enrolments?

Tier 2: Activity

- RQ3 Are the courses reaching target learner demographics?
- RQ4 What are the participation behaviours as learners progress through the course activities?
- RQ5 Does learner occupation have an impact on course participation?

Tier 3: Learner perception

- RQ6 Do learners see value in the type and level of content included in the course?

Tier 4: Knowledge

- RQ7 Are the assessments valid and reliable? That is, are the questions of a consistent level and aligned to the course content, and do they accurately assess knowledge gained from the course and retained by the learner?

Tier 5: Decision-making competence

- RQ8 Do the scenario activities effectively assess a learner's ability to make decisions about practicing diagnosis and management practices?

Tier 6: Task competence

- RQ9 How have learners used information from this course to change their professional practice?

Tier 7: Transfer

- RQ10 How is the learning from the course and/or assessments being practically applied by learners to their work environments?

Tier 8: Effects of transfer

- RQ11 Have learners shared information gained from the course with others in their communities to have a positive impact on plant protection practices and advice?[5]

[5] Same as Tier 7.

Data collection and analysis

This evaluation takes a mixed methods approach, collecting and analysing both quantitative and qualitative data. The quantitative data were collected from Google Analytics (GA), Moodle, and user profiles generated when new users registered on the CABI Academy. The qualitative data were collected from the free text response fields at the end-of-course questionnaires as well as from in-depth key informant interviews (KII) designed early in the evaluation process and collected by in-country CABI staff. The KII questionnaire and a summary table of the key informants are provided in Annexes 5 and 6, respectively. Further details on the target countries and data collection tools are given below.

Target countries

Three countries were targeted for evaluation during 2022: Bangladesh, Rwanda and Bolivia. These countries were chosen because promotional activities have taken place since 2020 with support from in-country partners. However, statistics of overall user trends across all available countries were analysed as needed, particularly to inform Tier 1 questions.

Data tools and sources

More details about the data sources and extent of data collection are provided:

- **Google Analytics (GA):** GA data is available from March 2021 to September 2022. This covers the time from when data tracking on GA was set up. GA collects data on page views and amalgamates this with technical information about the user's device and demographic data collected via other websites. The GA data collected and used in this report includes usage, location and demographic data.[6] It should be noted that GA data has limitations in data collection due to the option given to individual users to either accept or reject third-party cookies. As a result, learners may have chosen not to share their data which would reduce the amount of information available for this report. While this limitation may reduce the generalisability of the quantitative data, they will still help to inform and substantiate findings from the qualitative data.
- **User profiles:** User profile data is gathered for the year 2022 and is accurate as of 3 November 2022. Other user demographic data, such as occupation, is collected from these user profiles.
- **Moodle reports:** The Moodle data shown in the report is from February 2020 to 30 September 2022. Data include overall usage statistics, enrolments in courses, completion status on individual activities, certificates awarded and detailed data on questions in the end-of-course questionnaire. The data seek to paint a picture of the courses' effectiveness and impact. For this report, "completion" is defined as users who pass at least the Foundation level assessment which requires correctly answering at least 80% of the questions. The end-of-course questionnaire (see Annex 3) has been set up within the courses as mandatory to complete after the assessment. Learners can only download their certificate once both the questionnaire has been completed and the assessment has been passed.
- **Key Informant Interviews (KIIs):** Learners were selected from active users of CABI Academy who had completed the course, according to Moodle reports, and consented to being contacted by the CABI team. These learners were interviewed to gain more in-depth explanations to help illustrate and expand on the findings from the quantitative data collected for this study. More specifically, the interviews help illuminate how knowledge

[6] Google Analytics. About Demographics and Interests. Retrieved on 6 December 2022 from https://support.google.com/analytics/answer/2799357?hl=en#zippy=%2Cin-this-article

from the courses is being practically used and applied in professional practice, and the questions form a baseline for potential future evaluations. The learners were contacted virtually via Zoom and WhatsApp video calls as well as by face-to-face focus group discussions. The key informant questionnaire and list of key informants are detailed in Annexes 5 and 6.

- **Focus Group Discussions (FGDs):** In Bangladesh, two FGDs were held with eight students and four agricultural extension workers to confirm and validate some of the KIIs. The students and extension workers involved in the FGDs were different to those involved in KIIs because the former were selected from social media (Facebook, WhatsApp) groups as well as in-country contacts. The FGD checklist is found in Annex 4.
- **Online survey:** In 2021, a short survey was sent out to learners across all countries who accessed but did not finish the CPM course. This survey was to gain insight into the factors that were preventing learners from completing the course. The survey was conducted using Microsoft Forms and was sent via email to approximately 40 people.

Findings

Tier 1: Attendance

Barriers to enrolment and course completion

Overall enrolments

As of 8 November 2022, there were 14,848 registered users within the CABI Academy. A total of 6,920 learners enrolled onto the CPD course (with 738 enrolled onto the Spanish language version) and 2,013 learners enrolled onto all versions of the CPM course. Annual numbers are provided in Table 2.

It should be noted that enrolment numbers for CPD version 3.0 and CPM version 2.0 are approximate because learners enrol in individual modules which are set up as separate courses in Moodle, rather than the whole programme. As a result, numbers are taken from module 1 which has the largest number of enrolments. Additionally, the Spanish version of the CPD course existed until version 2.0, which is no longer in use. Account registrations do not include those people who have never confirmed their account.

Table 2. CABI Academy registrations and CPD and CPM enrolments 2020–2022.

	CABI Academy account registrations	CPD enrolments	CPD enrolments (Spanish)	CPM enrolments
2019	84	-	-	-
2020	8,266	4,359	711	234
2021	2,169	783	26	1,088
2022	4,329	1,778	1	691
TOTAL	**14,848**	**6,920**	**738**	**2,013**

Note: Data as of 8 November 2022

Barriers to enrolment

Barriers to enrolment that were observed for the CPD and CPM courses include language, sign-up and login processes, internet connectivity, and time availability of users. However, these findings are based on the insights of respondents who did ultimately enrol into the courses, and as such, may not capture other possible barriers.

Language

Earlier experiences with the CPD course highlighted that launching in English only would create a barrier to non-English-speaking countries. For this reason, CPD v2.0 was made available in both English and Spanish. Similar feedback was received from CABI's in-country coordinators, who were responsible for promoting the courses, in Bolivia (Spanish), Rwanda (French and Kinyarwanda), and Burkina Faso (French) regarding CPD v3.0, initially released only in English. During 2022, a translation system was developed within the CABI Academy, enabling users to switch to Spanish, French, Kinyarwanda, Uzbek, Turkish, Arabic, and Bangla. Initial translations are performed via Google Translate, with individual translations refined by subject matter experts as needed.

Although the Google Translate translations are not perfect, feedback indicates that this approach reduces barriers to enrolment. However, Spanish speakers have noted that imperfect translations may present a significant barrier. As a result, investment in full translations of the courses into Spanish may be necessary.

Sign-up and login processes

The sign-up system and associated login processes were reviewed by a User Experience expert in 2022, who provided recommendations to better help guide users through the processes. These include a series of step-by-step videos and a set of Frequently Asked Questions (FAQs) based on common queries from users as reported via Freshdesk (a ticket-based help desk system available for learners to access within the CABI Academy). The videos and FAQs are available through the Freshdesk Help button, which appears on every CABI Academy page.

Connectivity

Findings from the KIIs also identified connectivity as a potential barrier to access to the CPD and CPM courses:

> *"The digital learning method is the best since you can arrange and attend the classes in your free time. The only con about it is that you need reliable source of internet, power and a lot of commitment."*
>
> ***KII Participant***

This highlights the potential issues users face in accessing online educational materials. The courses are principally developed to reach those in developing countries, where access to technology and associated connectivity can be difficult and expensive. For example, a recent report from the International Telecommunication Union, a United Nations agency, found that 96% of the 2.9 billion people globally, who are yet to use the internet, live in developing countries (ITU, 2021). Furthermore, the Alliance for Affordable Internet found that internet prices remain unaffordable for 52 out of 95 low and middle income countries, according to the '1 for 2' measure which suggests that 1GB of mobile broadband data is affordable if priced at 2% or less of average monthly income (A4AI, 2021).

From the learners enrolled onto the CPD course, as of Moodle enrolment data from 23 November 2022, 24% are from low income countries, whilst 41% are from lower-middle income countries (Fig. 2). Given that MOOCs are often criticized for reaching primarily highly educated learners from developed countries, having the majority (65%) of enrolled learners accessing the course from low and lower-middle income countries (as defined by the OECD and World Bank[7]) suggests that the CPD course is outperforming global trends. Similar trends can be seen for enrolments for the CPM course (Fig. 3), where the majority of learners are accessing the course from low and low-middle income countries.

To address the challenge of reaching learners in developing countries, efforts have focused on promoting the offline capabilities of the Moodle App on android devices. These capabilities enable downloading sections of the course during internet access, with progress synchronized to Moodle upon the next internet connection. As global connectivity improves, access to CABI Academy courses is likely to expand and benefit more individuals.

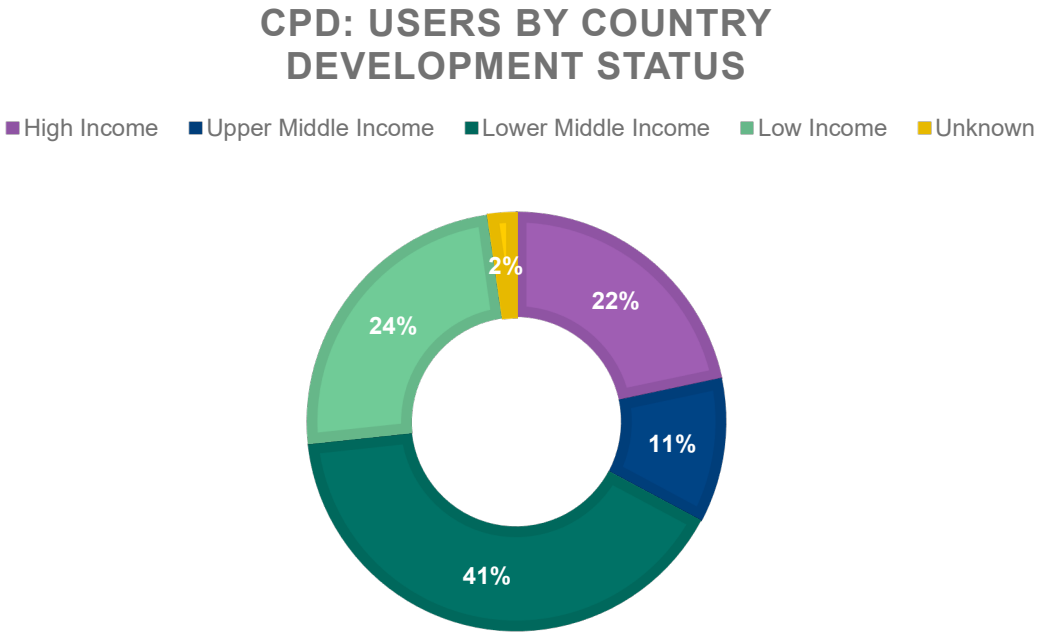

Fig. 2. CPD Users by country development status.
Note: Data as of 23 November 2022.

[7] OECD and The World Bank. Data sources for country development status categorisation. (OECD and The World Bank). Retrieved on 6 December 2022 from https://www.oecd.org/dac/financing-sustainable-development/development-finance-standards/DAC-List-of-ODA-Recipients-for-reporting-2022-23-flows.pdf and https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups

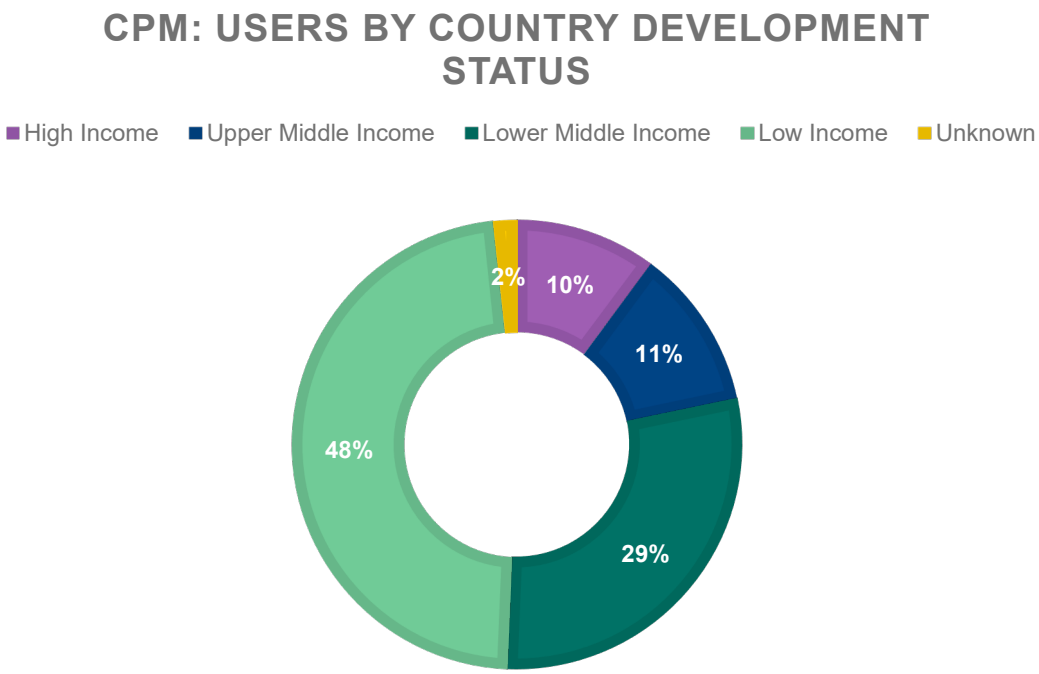

Fig. 3. CPM Users by country development status.
Note: Data as of 23 November 2022.

Time

As well as language and connectivity issues, several Key Informants shared that having enough time for independent study was also a barrier to signing up to the courses. Self-paced courses offer adult learners the option to access learning materials around their schedule, giving them autonomy over their learning needs (Lan and Hew, 2020). Findings from the online survey in 2021 and KIIs conducted for this report found that extension workers (one of the target learner groups for these courses) often have very high workloads which can lead to difficulties in dedicating time to continued professional development activities. This is supported by Freshdesk requests from learners to extend their access to the courses during the 3-month period between 2020 and 2021 when the courses were made freely available.

Completion and leaver rates

Figure 4 displays the completion[8] rates for the courses across the target countries between 2020–2022, while Fig. 5 shows the number of enrolments to the courses during the same period. In 2020 and 2021, the overall percentage of enrolled learners (with free access) awarded a certificate after completing an assessment in the CPD and CPM courses were 46.8% and 30.9%, respectively. However, in 2022, the completion rate declines sharply for Rwanda and Bolivia while it remains the same for Bangladesh. This decline could be partly attributed to the end of the free trial period from the previous years, which removed a key incentive to participate, or perhaps the length of the courses, especially the CPM course, which has consistently posed a challenge for sustained engagement. Moreover, the CPD course was no longer offered in Spanish starting in 2021, so only the CPM course was available for users in Bolivia. At the same time, broader external factors could also have been possibly at play, such as the easing of pandemic restrictions which may have shifted participants' priorities back to in-person work, including a return to more traditional, face-to-face delivery of training modules. Without strong institutional promotion or professional

[8] A 'completion' is defined as a user who passes at least the Foundation level assessment.

incentives to enhance learner motivation and follow-through, it is difficult to mitigate the reduction in course completions. Nevertheless, course uptake is noted to increase overall in 2022, largely driven by more enrolment by learners in Bolivia.

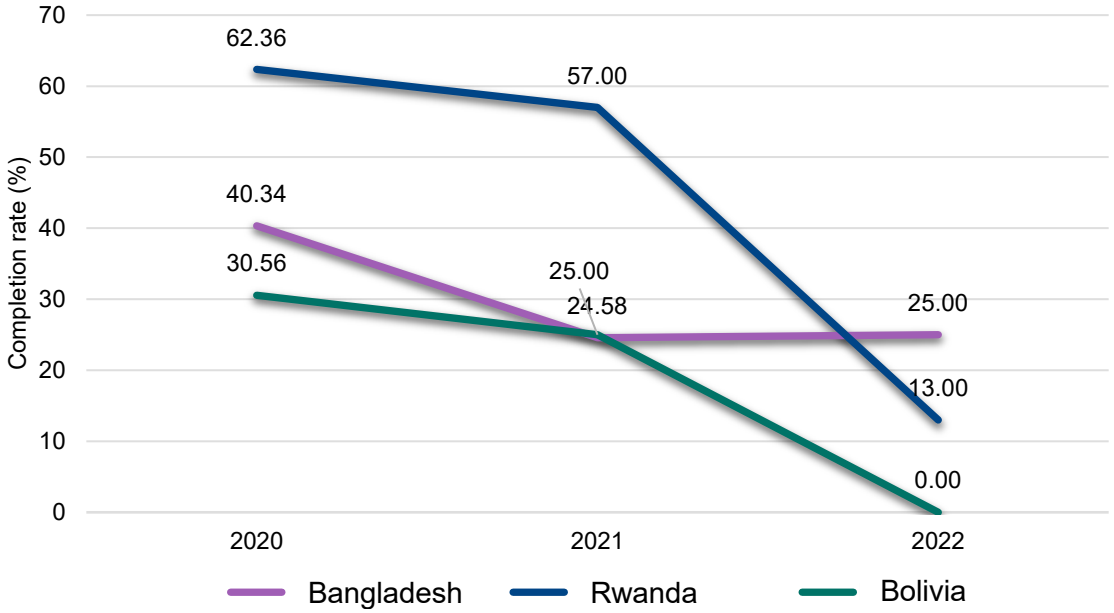

Fig. 4. Percent year-wise completions of both courses, based on certificates awarded.
Source: Moodle data.

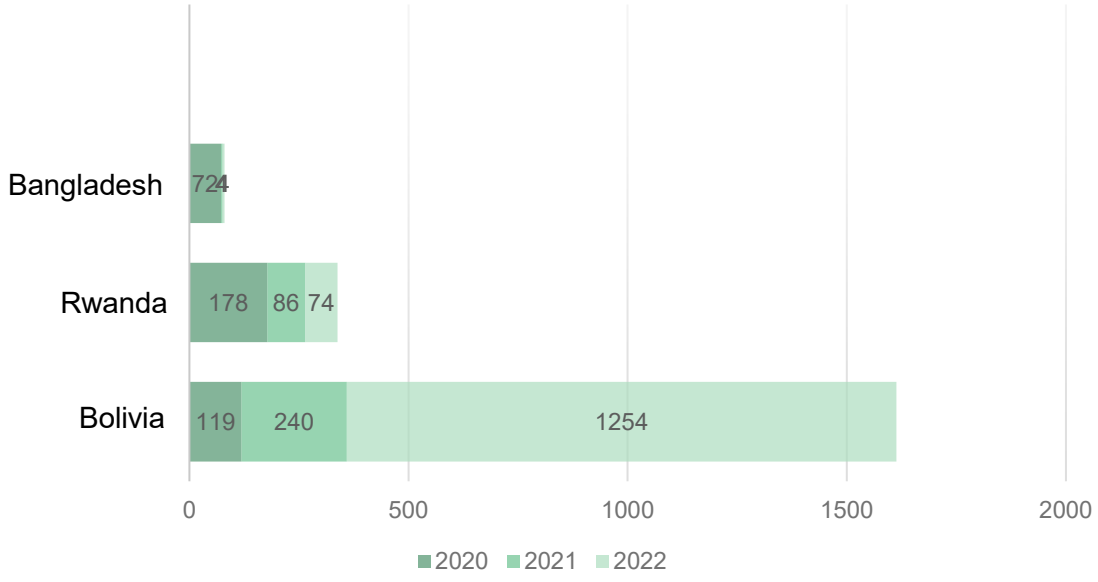

Fig. 5. Uptake of the courses (enrolments) in the selected countries.
Source: Moodle data.

The GA data shows the engagement rate (percentage of engaged sessions[9] to total sessions) of the learners for Bangladesh, Rwanda and Bolivia as 79.1%, 51.9% and 51.1% respectively. This engagement rate, alongside similar rates with course enrolments and completions (based on certificates awarded) from these countries, suggests that the courses provide value for a high number of our learners who continue to maintain high levels of motivation to go on and complete the course by visiting course pages, engaging in activities and completing the assessments. Self-study, online-only courses, like MOOCs, traditionally have low levels of completion rates (Jordan, 2015), yet over half of learners on the CPD and CPM courses from target countries are maintaining engagement in the courses. In fact, the average measured engagement time is over 40 minutes, demonstrating the value learners see in the content as well as the commitment from learners in wanting to complete the course through to certification.

Despite the identified barriers to enrolment, the number of people actively self-enrolling onto the courses indicate that these courses and certifications fill an important need in these subject areas. This finding is supported by responses from the KIIs, where learners shared positive course experiences:

> *"I had a very good experience taking this course. I enjoyed it a lot. Before completing this course, a lot of times, I confused which one is fungal symptom or bacterial. After competing this course, I feel more confident."* (CPD learner)
>
> *"I learnt many important things in this course such as differentiating among various disease, insect, fungus and bacterial infections. I know now how to systematically diagnose damaged crop. I have got a good idea to diagnose all type of pest problems."* (CPD learner)
>
> *"I am very happy to learn so many things related with practical disease management practices."* (CPM learner)

Effect of promotional activities on learner enrolments

Course promotion

In 2020 and 2021, there were low levels of in-person promotional engagement for the CABI Academy courses due to global COVID-related travel restrictions. To compensate, online promotional activities were conducted. For example, CABI staff used a range of social media platforms such as Telegram, LINE and WhatsApp to disseminate course access information. Direct emails were also sent to existing CABI Academy user profiles to inform existing users about the launch of new courses.

Once travel restrictions were relaxed in 2022, more local engagement was reintroduced into the mix of existing promotional activities. For example, a 'Communications Toolkit'[10] was created and first tested in Bangladesh before being used and iterated for subsequent rollouts. This testing included in-person orientation training with "master trainers", or early adopters of the toolkit who would later train others, and they helped to increase the uptake of the courses amongst junior colleagues and the wider population.

[9] An engaged session is a session that lasts longer than 10 seconds, has a conversion event, or has at least 2 pageviews or screen views.
[10] CABI Academy Communications Toolkit. https://trello.com/b/hWgozLcT/cabi-academy-communications-toolkit

The different ways in which users can arrive at the CABI Academy are defined below.

- **Direct** entering or selecting the direct CABI Academy website
- **Organic searches** refer to the links that appear in search results that are not paid advertisements
- **Referrals** refer to users that come to the site via a link from another site (not a search engine or social media)
- **Organic social** refers to users that come to the site from a post on social media that is not an advertisement
- **Email** refers to users that come to the site from a link in an email. These users have already signed up to the CABI Academy and have actively given permission to receive marketing emails

Direct methods of engagement with learners appear to be more effective in promoting the CABI Academy to target groups as compared to broader, less targeted promotion activities on social media. This finding is supported in Fig. 6 which shows that most users arrived at the CABI Academy website via direct search (entering or selecting the direct CABI Academy URL) (73.0%). Visits from organic searches (5.5%), referral (4.6%), organic social (4.2%) and email (1.2%) were comparatively lower. Email has a relatively small effect because this method relies on users who have already signed up to the CABI Academy and have actively given permission to receive marketing emails.

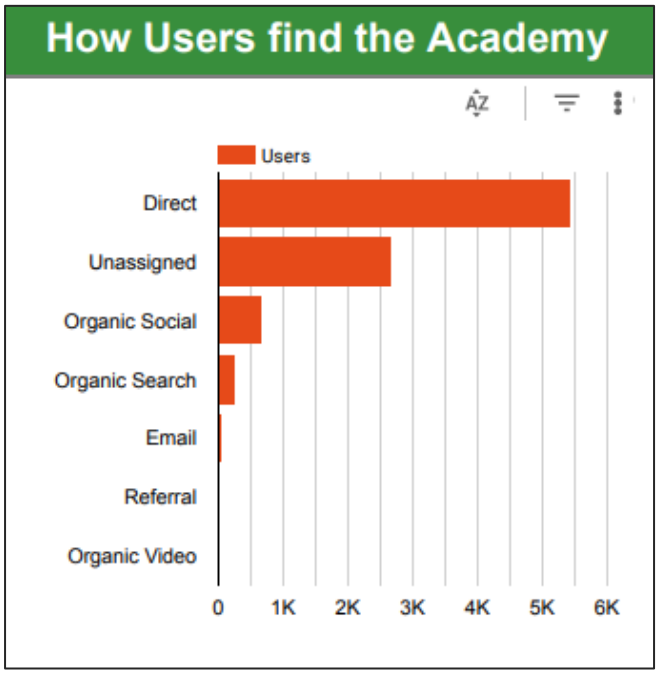

Fig. 6. Traffic to CABI Academy website.
Source: Google Analytics data.

Tier 2: Activity

Course reach of target learner demographics

Target learner demographics: Age, gender and device

Figures 7–10 display data captured via Google Analytics to show the target learner demographics of age, gender and device for Bangladesh, Rwanda and Bolivia, and overall.

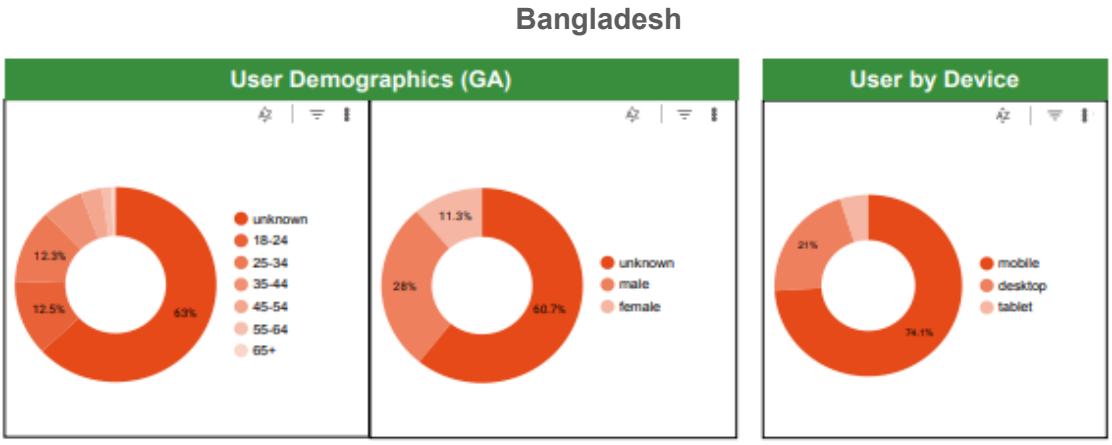

Fig. 7. Bangladesh usage by age, gender and device.
Source: Google Analytics data from March 2021–September 2022.

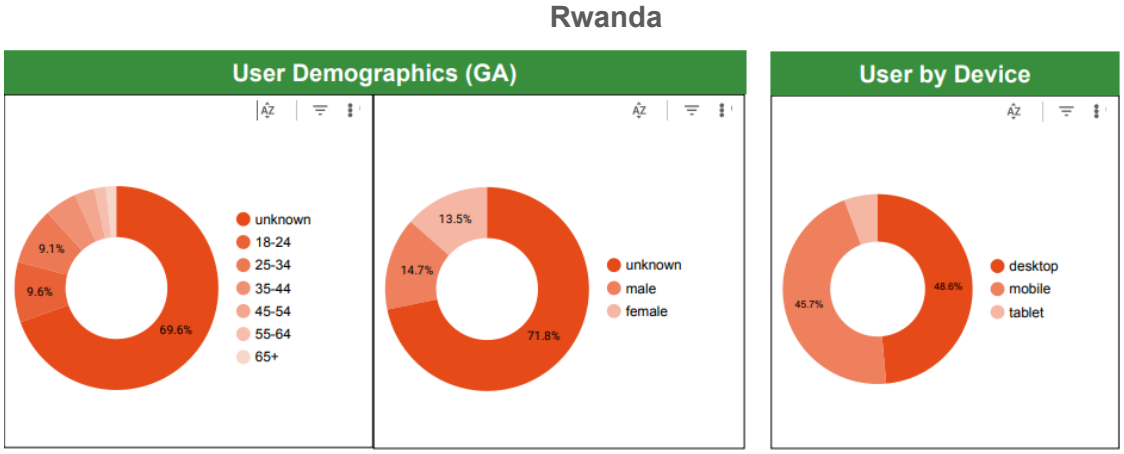

Fig. 8. Rwanda usage by age, gender and device.
Source: Google Analytics data from March 2021–September 2022.

Bolivia

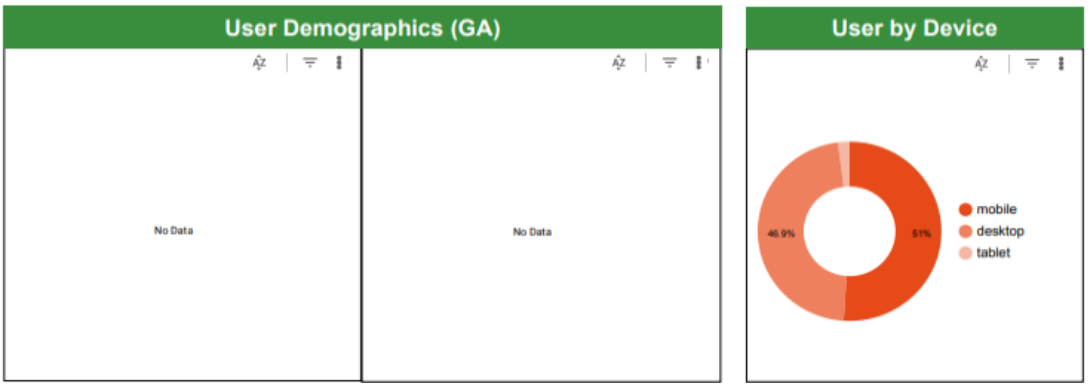

Fig. 9. Bolivia usage by age, gender and device.
Source: Google Analytics data from March 2021–September 2022.

Overall

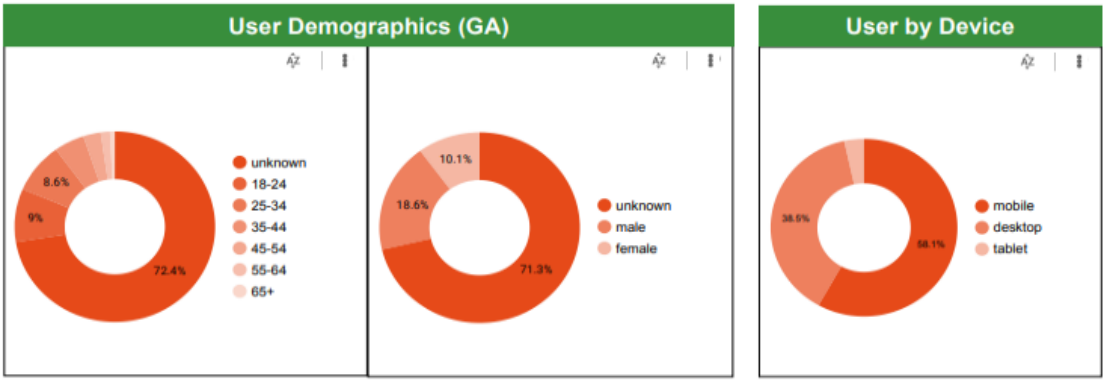

Fig. 10. Overall usage by age, gender and device.
Source: Google Analytics data from March 2021–September 2022.

Age demographics

While the target learners from the CPD and CPM courses cover a broad range of demographics, most are expected to be in the age range between higher education and retirement, or approximately 18–57 years old[11]. For Bangladesh and Rwanda, the largest proportion of learners fall into the 18–44 years age group (see Figs 7 and 8), while user demographics could not be generated for Bolivia due to not meeting the minimum requirement of 10,000 visits (see Fig. 9). It should be noted that there is some uncertainty regarding the age and gender of users due to the way data is collected by Google Analytics[12]. Nevertheless, the overall data indicate that most visitors are within the age groups of 18–24, 25–34, and 35–44, suggesting that the CPD and CPM courses appear to be reaching the intended targeted age groups.

These age groups were also represented in the KIIs which included extension workers aged between 25–44 years as well as students aged between 18–24 years. The extension workers mentioned that they took part in the courses to learn more and to expand their future prospects, whereas the expectation of students was to enrol into the courses for the purposes of enriching their curriculum vitae.

[11] Retirement age in Bangladesh is 57.
[12] Google Analytics. What is "unknown" is gender demographics? Retrieved on 6 December 2022 from https://support.google.com/analytics/thread/118589045/what-is-unknown-is-gender-demographics?hl=en

"I did CABI Academy courses as I wanted to complete the relevant courses from reputed international organizations to enrich my curriculum vitae as I want to do further studies in a foreign country."

Master's student from Bangladesh

Gender demographics

Engagement with the CABI Academy varied between men and women depending on the country. For example, in Rwanda, men and women access the CPD and CPM courses relatively equally (male to female ratio of 10:9.18), while in Bangladesh, access is more heavily dominated by men (ratio of 10:4.04) (see Figs 8 and 7). GA does not provide gender disaggregation data for Bolivia. Overall, the data show that more men than women are accessing the site (ratio of 10:5.43).

This finding aligns with a MOOC study as well as recent sector report which reveal that men access online learning more than women, and this result suggests that women may be missing out on opportunities to upskill using online learning, perhaps due to a lack of access to devices and internet connectivity (Groupe Speciale Mobile Association, 2021; IFC, 2022). That being said, female participation in online learning saw growth during the COVID-19 pandemic, even in Bangladesh (Mamun-ur-Rashid *et al.*, 2018), so more targeted marketing could take place in the future to further promote courses to women working in agriculture. Moreover, the CABI Academy could request for gender-specific feedback from learners, as well as from those who have yet to access the courses, about potential barriers to access that need to be overcome.

Device usage

The data reveal that many learners used mobile devices to participate in the courses. Mobile usage was higher in Bangladesh (74%) than in Rwanda (45.7%) and Bolivia (51%) (see Figs 7–9). This finding was substantiated by the KIIs in Bangladesh who mentioned that the users were more comfortable in completing the courses on their mobile phones. All eight learners (100%) participating in the FGD in Bangladesh shared that they used their mobile phones to access the courses because they have limited access to other devices such as desktop computers, laptops or tablets. During a facilitation training event organized for CABI Academy courses in Bangladesh, all 60 participants accessed the courses via their mobile devices.

"Because of my field job, I have to travel a lot, so I mostly accessed the Crop Pest Diagnosis course on mobile while commuting."

Private sector extension worker selling organic fertilizer

Overall site usage data also show maximum usage of the CABI Academy website is via mobile phones (58.1%) as compared to desktop (38.5%) and tablets (3.4%) (see Fig. 10), which resonates with data that show mobile internet usage to be more popular than desktop in most countries in the developing world.[13] According to key informants, factors that would enable the selected countries to continue supporting digital learning include 1) internet data and bandwidth, 2) access to devices, and 3) sufficient digital literacy of learners. Understanding these factors will help to inform future course design decisions, development practices for new products, as well as retrofit the CPD and CPM courses to ensure they are fully mobile responsive.

[13] HighSpeedInternet.net. (2022). Desktop and Mobile Internet Usage Statistics - 2022 - High Speed Internet. Retrieved 6 December 2022 from https://www.highspeedinternet.net/desktop-and-mobile-internet-usage-statistics/

Participation behaviours as learners progress through the course activities

As learners move through the modules sequentially, their engagement reduces with progression through the course modules. Figures 11 and 12 illustrate this trend by showing that there have been a high number of learners starting but not completing the course[14]. The data from the CPD course also shows that a number of learners are not visiting the Welcome module and are moving straight onto to the first content module. In response to this finding, for new courses, this module has been renamed 'Get started'. This data, alongside additional feedback from key user testers, suggests that 'Module 0' demonstrated a low level of importance to learners.

The courses have been designed so that learners can attempt the assessments at any point, without the need to work sequentially through the course modules. This is to allow learners to gain a certificate to demonstrate their level of knowledge in the areas of CPD and CPM, if they are already confident in these topics. This means that in some cases, learners attempt the assessments before, or without, completing the course modules. Figures 11 and 12 suggest this pattern by confirming that a high number of learners attempted the Foundation assessments but only 30% of attempts were awarded certificates. Interviews with key informants reveal that the CPM course is too long for some, and they struggled to find time to commit to finishing it, which may explain why learners are attempting the assessments before completing the modules.

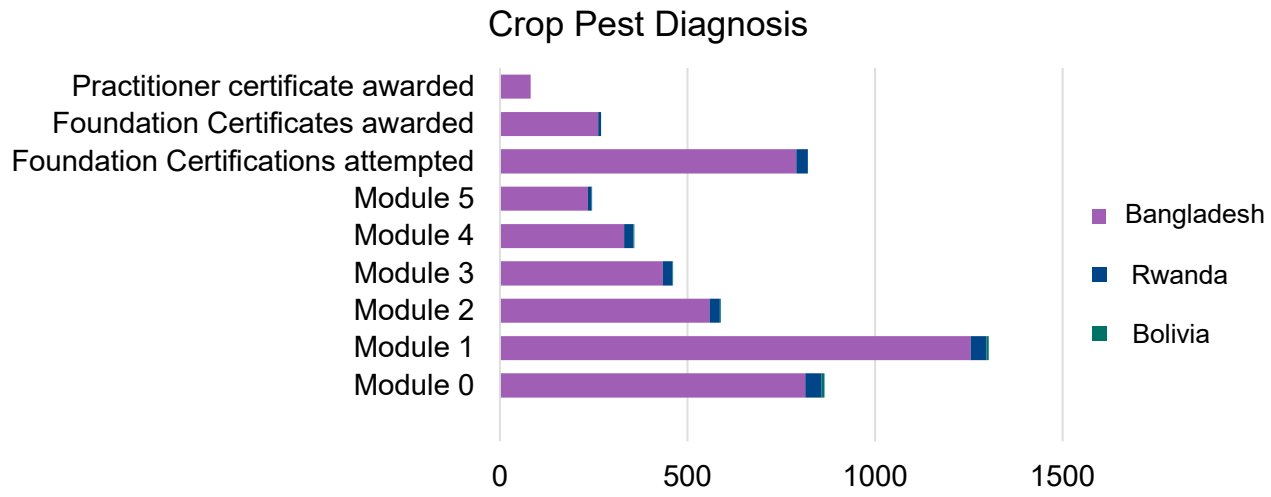

Fig. 11. Learners' activity through the course sections, CPD course (2022).
Note: Measured by enrolments into each module, compared to assessment attempts and passes.

[14] Remembering that completions are measured by the number of certificates awarded

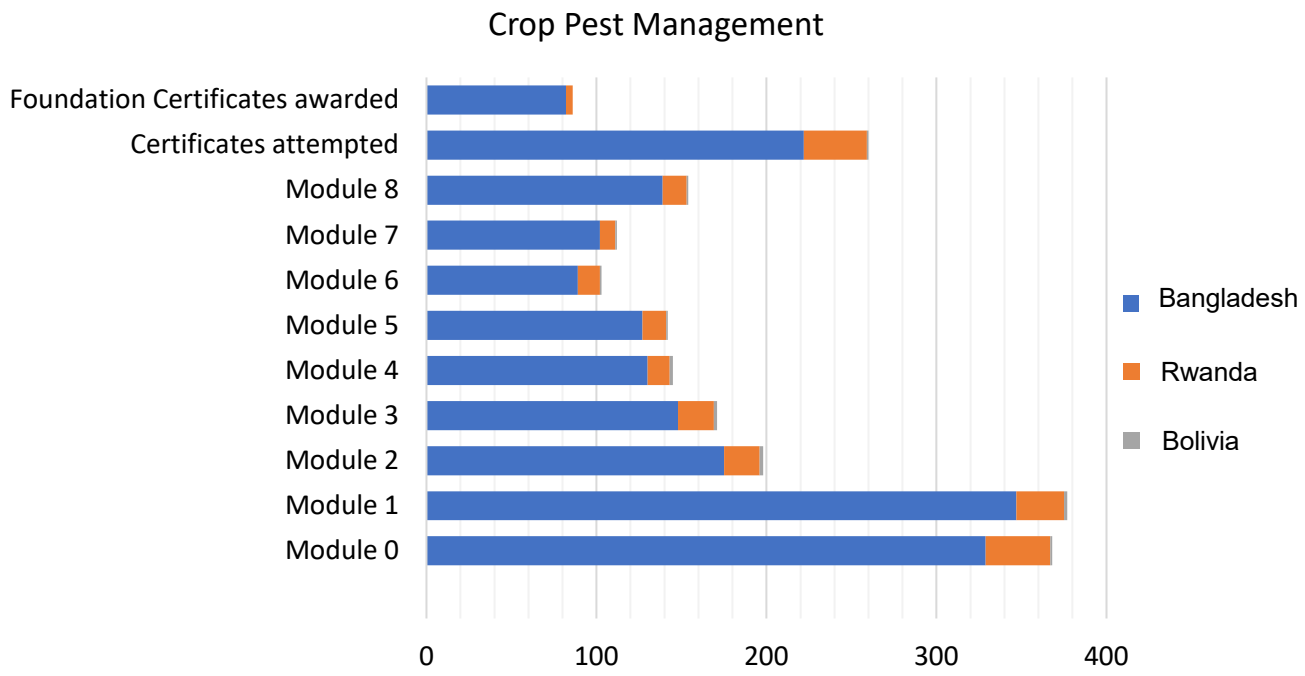

Fig. 12. Learners' activity through the course sections, CPM course (2022).
Note: Measured by enrolments into each module, compared to assessment attempts and passes.

Furthermore, key informants shared that, whilst the CPD course is important for learning about the causes of pest and disease problems in the field, once learners are aware of the issues, they can find ways to manage pests and diseases from colleagues and from other external sources.

> *"Normally diagnosing the pest problems in the field accurately is very critical. Once correctly diagnosed, I can ask for recommendations from my colleagues or recommended government advice given for the pest."*
>
> ***Agricultural extension worker from Bangladesh***

> *"I personally enjoyed CPD course more, because if you don't know how to diagnose you can't do anything. But you can ask colleagues for management advise. I found the CPM course more difficult than CPD."*
>
> ***Agricultural extension worker from Rwanda***

These results from the user data as well as insights from key informants highlight the need to adjust the courses to better fit the time availability of learners and provide more information that suits their needs. Some potential strategies include:

- Reduce the amount of content in the CPM course
- Provide stronger links between the CPD and CPM courses
- Remove numbering system from the modules
- Include a wider range of sources and resources in the CPM course to compete with the types of resources learners are finding elsewhere, namely management methods

Association between learner occupation and course participation

Type of role or occupation

In Bangladesh, the highest number of enrolments into the CPD course were from learners in civil service roles followed by technological, advisory, student, training, administrative and scientific roles, as shown in Fig. 13. However, learners who identified themselves as students seem to be more likely to complete (gain a certificate for the foundation assessment) than any other role. This finding is highlighted in the proportion of completed attempts (enrolled users who were awarded with the certificates for foundation assessment) which was highest for students (53%) followed by civil service (34.3%), administrative (31.03%), agribusiness (15.38%) and advisory (11.45%). It should be noted that learners can test their existing knowledge of the course material before going through a module by directly going to the assessment, as guided by the help text in the course. This allows them to compare their scores before and after the module, and a certificate is granted if they score greater than 80% on the assessment. Thus, it is possible that a greater proportion of students are completing the courses because they have recently gained the knowledge to pass the foundational assessment.

A similar trend can be seen for the CPM course where enrolments are highest amongst learners with civil service roles, but completion rates are highest amongst students, as shown in Fig. 14. Key informants in Bangladesh reveal that those learners representing themselves as civil service, administrative or advisory roles are likely working as agricultural extension officers under Department of Agricultural Extension. These officers often have a high amount of implementation work to complete, supporting the previous finding that lack of time is a key barrier for learners. It is also possible that a face-to-face course orientation training that was provided for 60 learners in Bangladesh increased the number of enrolments, and that many of these learners did not complete the courses, ultimately resulting in low completion rates for those with advisory roles.

In contrast, learners in Rwanda were largely engaged in farming, scientific, administrative and advisory roles, as shown in Figs 15 and 16. Moreover, completion rates for the CPM were relatively equal across these four roles, whereas completion rates for the CPD course were highest amongst those in scientific roles (40%) followed by agribusiness (25%), administrative (25%) and advisory (20%) roles. However, the overall completion rate for both courses was quite low: 16% and 19% for the CPM and CPD courses, respectively.

There was not enough data available for Bolivia to be included in this report.

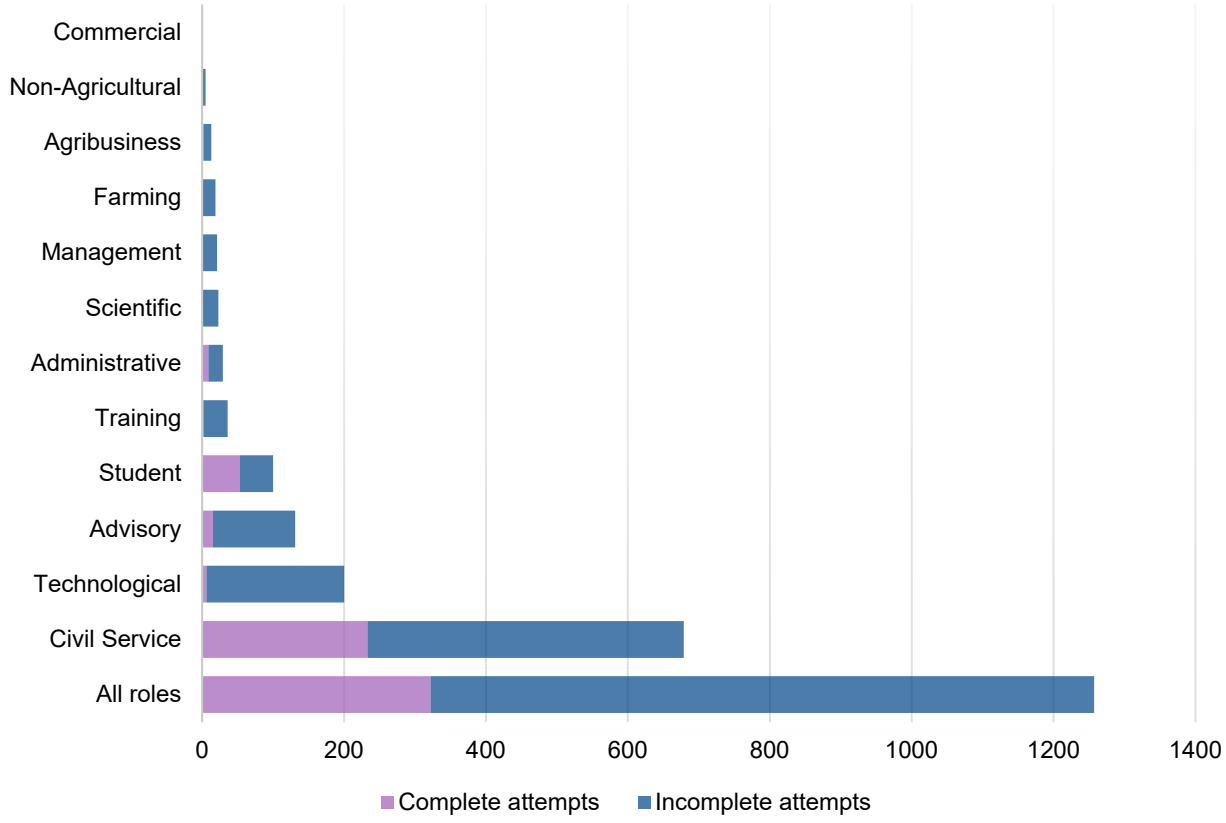

Fig. 13. Uptake of CPD course by learners in Bangladesh by job role or occupation.

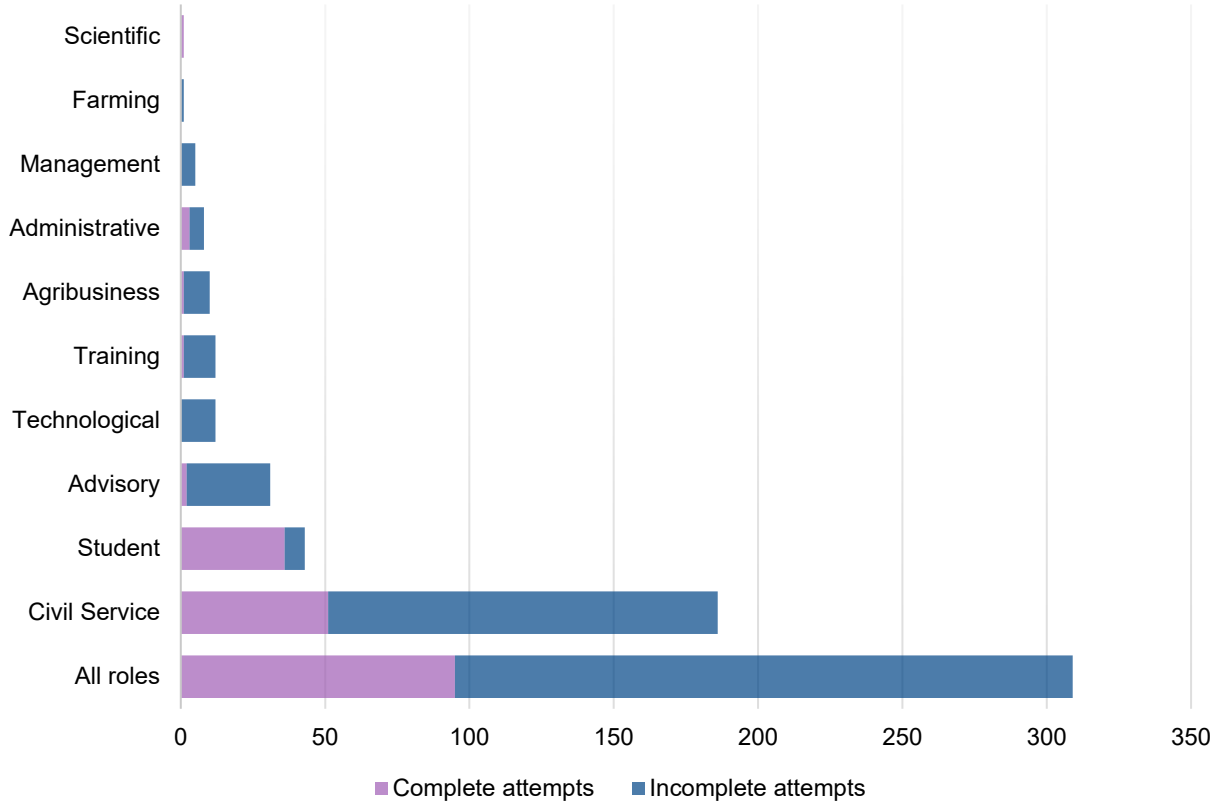

Fig. 14. Uptake of CPM course by learners in Bangladesh by job role or occupation.

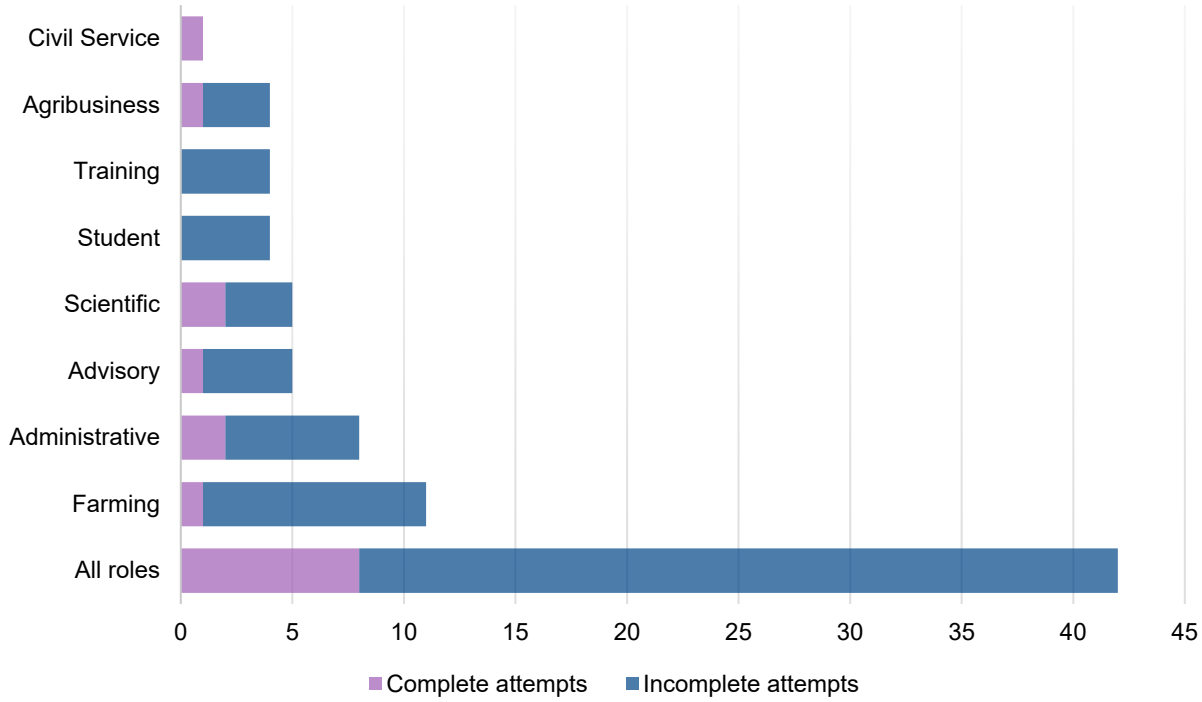

Fig. 15. Uptake of CPD course by learners in Rwanda by job role or occupation.

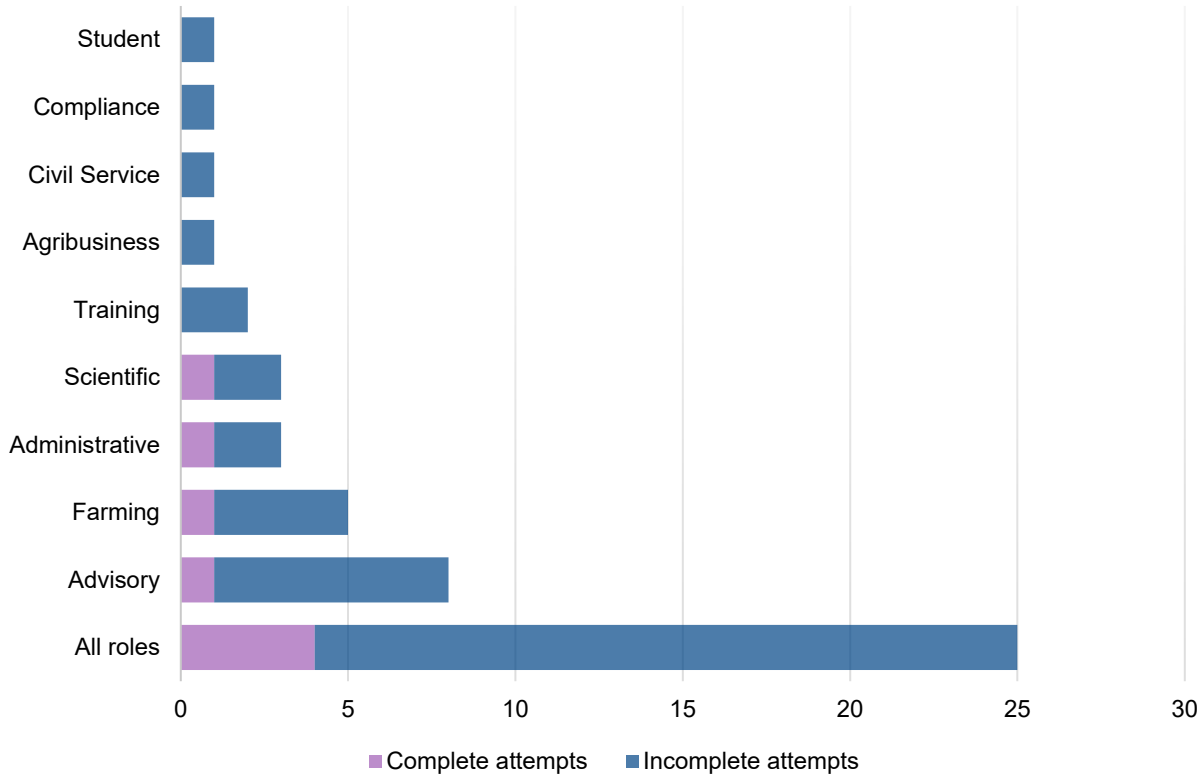

Fig. 16. Uptake of CPM course by learners in Rwanda by job role or occupation.

These results suggest that fewer extension workers in Rwanda engaged with the course than those in Bangladesh. This is potentially due to the fact that the number of promotional activities that took place in Rwanda was lower than in Bangladesh.

The large proportion of incomplete to complete attempts from those in farming roles may suggest a lack of relevance of the course content for the farming context specifically. This is not surprising, given that the content included in the CPD and CPM courses was designed specifically for trainers, students and those in roles that support farmers. A more farmer-specific version of the course may need to be developed if farmers are considered to be key end-users.

Overall, the variations in the percentage enrolments across the different type of job roles could be due to different modes of dissemination, promotional activities and partner engagement conducted in-country. On the other hand, learner completion appears to depend on factors such as motivation, time availability, access to alternative content sources, and the relevance and appeal of the course content to specific job roles and occupations. Further research is needed to quantify how different modes of dissemination impact enrolment numbers as well as better understand why some types of learners, such as students in Bangladesh, seem to have more motivation to obtain the course certificates.

Tier 3: Learner perceptions

Value of course content to learners

343 learners from the CPD course and 138 learners from the CPM course submitted feedback via the end-of-course questionnaire in 2022. We then performed sentiment analysis via the MonkeyLearn Sentiment Analyzer on the overall feedback (free text response). The response was found to be 97.2% positive.

Value of course content to job roles

Based on the end-of-course questionnaires, it was found that a large majority of respondents felt that they could apply learning from the course to their job roles, as displayed in Figs 17 and 18. This result was supported by responses from the KIIs:

> *"This course helps to compare and contrast different management techniques for each pest group and helps to distinguish between different types of control and learn to integrate these techniques in an effective, practical, economical and safe approach. It also helps to recognize the trade-offs in pest management decisions." (CPM learner)*

> *"This course is impressive and educative. It will help the students to learn about many new crop diseases and their management practices." (CPM learner)*

This finding would suggest that these learners saw the relevance and value of the course content in relation to their job roles. A potential caveat of this finding is that respondents to this questionnaire are amongst the most highly motivated to complete the course, as learners would have had to have worked all the way through the course content to reach this questionnaire and will have needed to complete the questionnaire before they were able to obtain their course certificate. Nevertheless, it demonstrates the relevance of the course content to their job roles, which enables them to change their professional practice by actively implementing the crop pest diagnosis and management methodology.

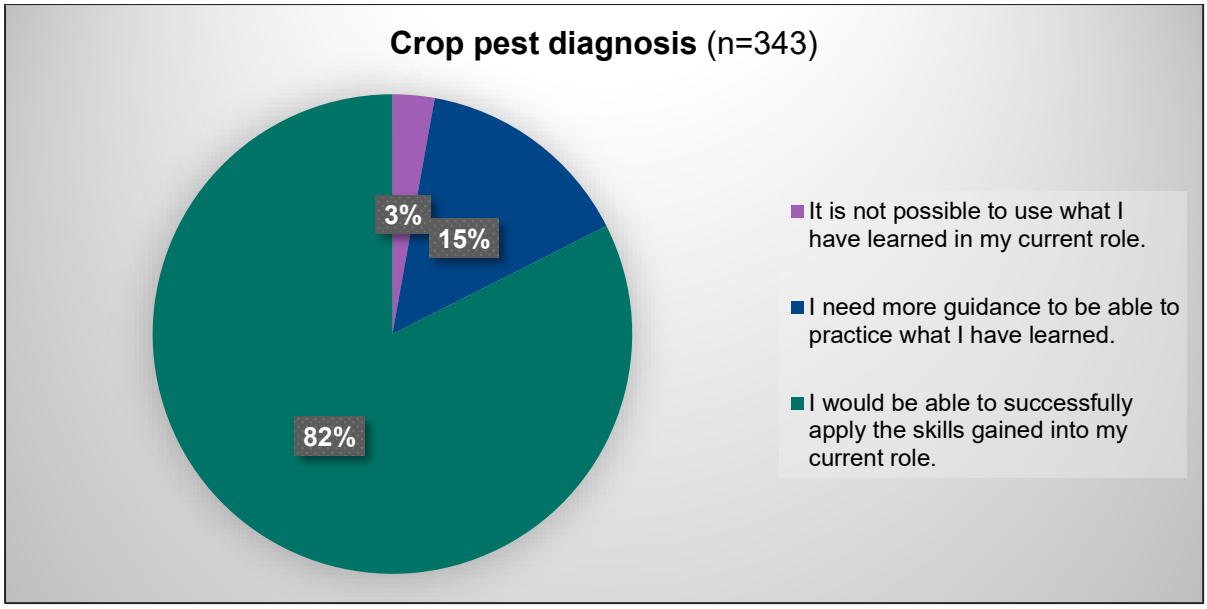

Fig. 17. Applicability of CPD course to learners' current job.

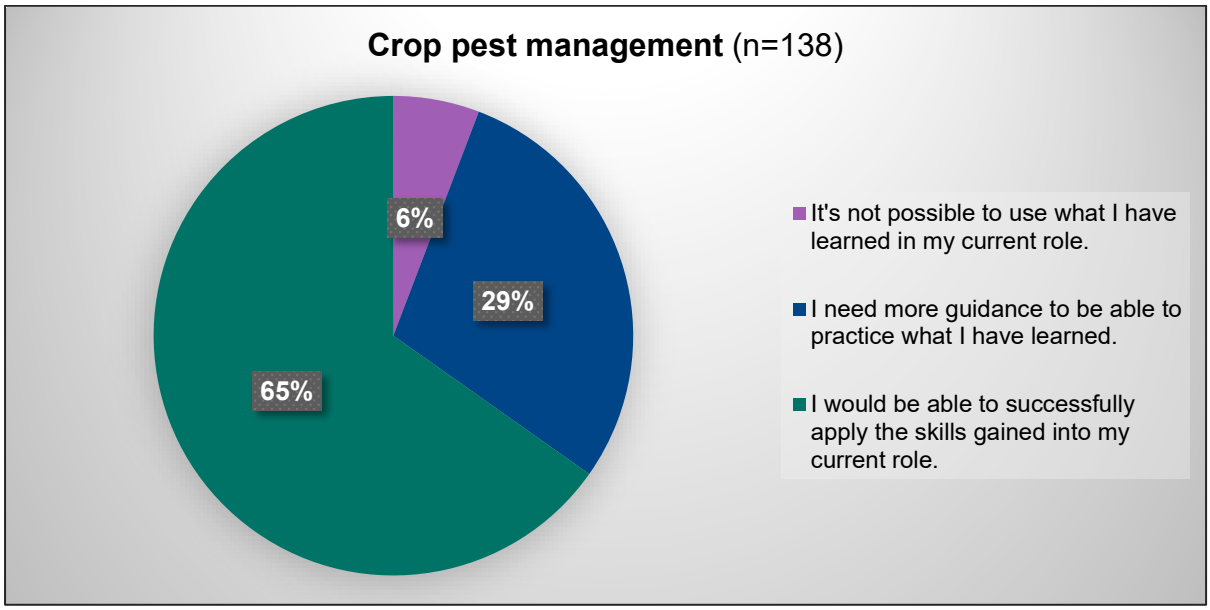

Fig. 18. Applicability of CPM course to learners' current job.

Using surveys and questionnaires to ask learners directly about their learning experiences and for perceptions about the value of their learning experience is a common method used to generate feedback. However, this method can provide inconsistent results and has been recognized as a problem in terms of generating quality data about the effectiveness of a learning experience (Thalheimer, 2016; Neelen and Kirschner, 2020). To mitigate this challenge, the questions included in the end-of-course questionnaires (Annex 2) were designed to offer the most value possible. This meant removing Likert style questions where possible and including response options that were more specific and practical. For example, the two responses: "it is not possible to use what I have learned in my current role," and, "I need more guidance to be able to practice what I have learned," demonstrate a practical difference between the amount of guidance available in the course and its relevance for learners to effectively enable them to apply the learning from the course to their roles.

It is also worth noting that this type of survey is unlikely to have reached many learners who did not see value in the course content, and so the perspectives of learners who did not see value in the course content are more difficult to include using the data collection methods employed for this report. And while the number of respondents isn't necessarily representative of the wider sample, it does show that a significant number of learners (CPD = 343 and CPM = 138) were motivated to work through a large amount of course content and saw value in obtaining a certificate to demonstrate the skills they gained from the courses.

Relevance of course modules to complete assessment

The end-of-course questionnaire also asked learners to select the course modules they used to help them complete the assessments. Respondents generally felt that, except for the welcome module (Module 0) in the CPD course, all modules were equally important in helping them complete the assessment, as shown in Figs 19 and 20.

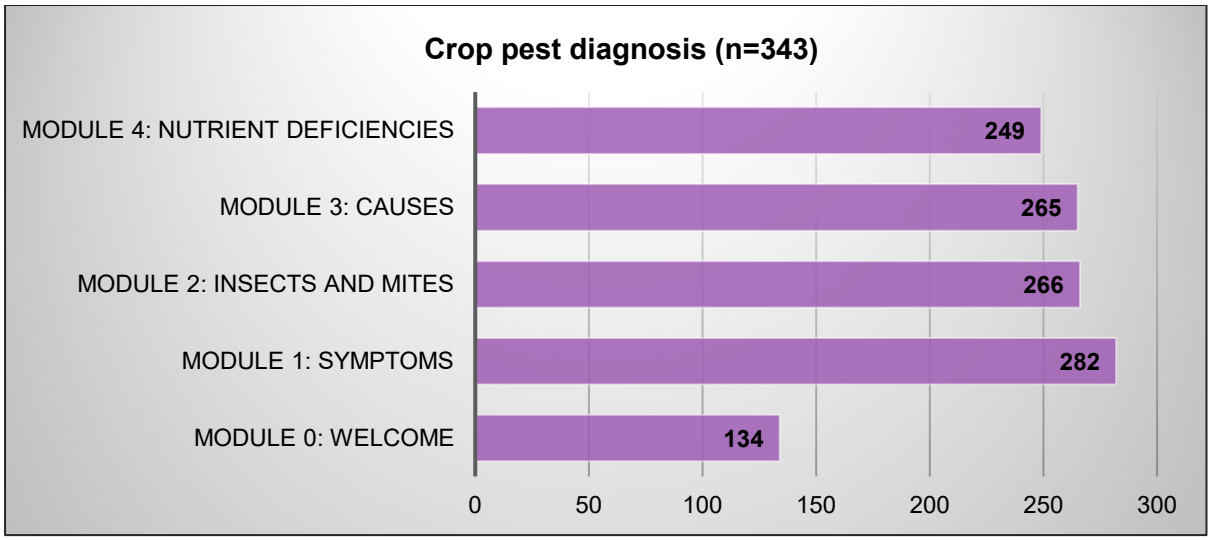

Fig. 19. CPD course learning modules taken to complete the assessment.

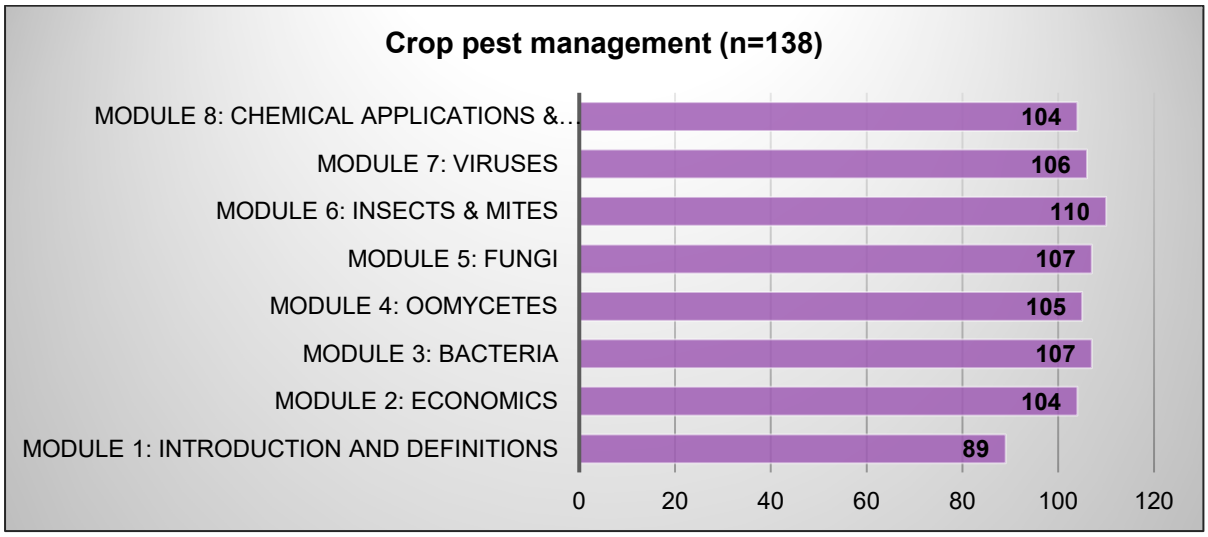

Fig. 20. CPM course learning modules taken to complete the assessment.

Tiers 4 and 5: Knowledge and decision-making competence

Validity and reliability of assessments

Assessment overview

There are two assessments within each of the CPD and CPM courses: Foundation assessment and Practitioner assessment.

Validity is often defined as, “the degree to which a test or measuring instrument actually measures what it purports to measure”, while reliability is described as, “a measure of consistency over time and over similar samples” (Oluwatayo, 2012). The Foundation assessment is valid because it is designed to measure the extent to which learners can accurately recall information from the course. Similarly, the Practitioner assessment is valid because it is designed to measure the extent to which learners can apply information from the course to a set of real-world-based scenarios.

The reliability of both assessments is determined by analysing Moodle data to observe average results of learners and understand their ability to consistently answer questions over time as well as by defined job roles. This analysis has allowed for improvements to be made and will continue to be made to the assessments on this basis. The Moodle-generated reports also provide data on the items listed in Table 3.

Table 3. Summary of Moodle report items and associated notes.

Report item	Notes
Average grade of first attempts	
Average grade of all attempts	The pass mark is 80%. Participants can take as many attempts as they need. Each time they will receive a different set of questions, selected from question banks (for example, 3 questions from bank one, which may contain 9 questions in total)
Average grade of last attempts	
Average grade of highest graded attempts	
Median grade (for highest graded attempt)	
Standard deviation (for highest graded attempt)	
Score distribution skewness (for highest graded attempt)	A negative value indicates a skew to the left of the distribution curve
Score distribution kurtosis (for highest graded attempt)	High values (> 3) indicate large numbers of outliers

CPD Foundation assessment

There have been three different iterations of the CPD Foundation assessment:

- **Version 1** of the CPD course included knowledge checks but no certification assessment. This was a prototype that received little traffic.
- **Version 2** included a new certification assessment, based on questions from the knowledge checks. This was available to users during 2020 and 2021. This received a lot of traffic.

- **Version 3** brought a complete revision to the assessment, based on our analysis of the performance of the version 2 assessments. This is the version that was actively promoted during 2022.

Figure 21 shows the distribution of scores, comparing version 2 (based on 10,917 attempts) and version 3 (based on 2,532 attempts) of the CPD Foundation assessment. It can be seen that the scores are more evenly distributed in version 3, with a more central median, and that more people are starting version 3 and getting a score of zero.

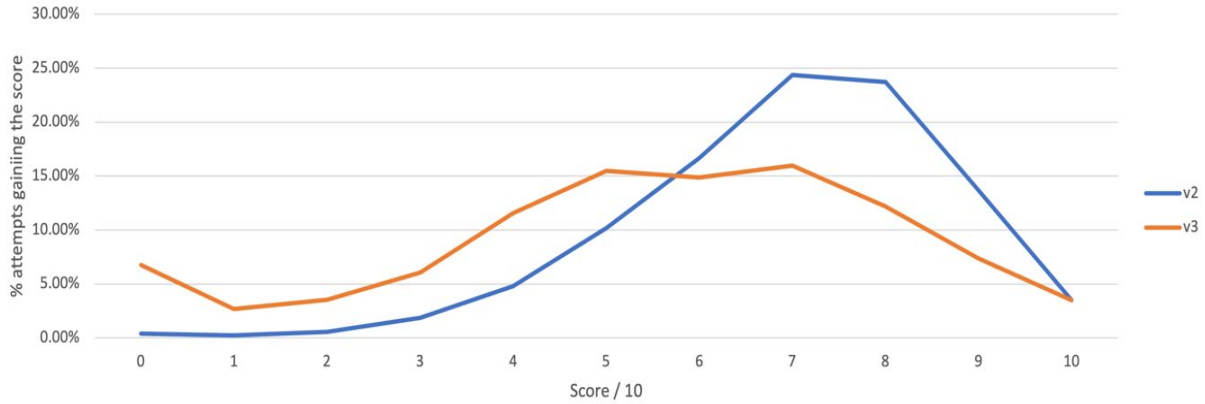

Fig. 21. Distribution of attempt scores for CPD Foundation assessments.

More information can be revealed about this comparison between versions 2 and 3 of the CPD Foundation assessment by analysing the performance of each question item using the facility index and discrimination efficiency. The facility index simply shows "the average score on the item, expressed as a percentage"[15] while the discrimination efficiency shows "the correlation between the score for this question and the score for the whole quiz"[16]. A higher discrimination efficiency indicates that the question is more effective at differentiating between higher and lower performing students on the overall assessment.

Figure 22 displays the relative efficiency of the questions for version 2 based on 2,528 attempts. The x-axis indicates the position of the question in the assessment, but since each attempt produces a different set of questions to the learner, this graph is simply an indication of the quality of the assessment. When compared to Fig. 23, which shows the performance for version 3 based on 665 attempts, the increase in the discriminative efficiency suggests that version 3 of the assessment is performing much better than version 2.

[15] Moodle. Quiz statistics, calculations, facility index. Retrieved on 6 December 2022 from https://docs.moodle.org/dev/Quiz_statistics_calculations#Facility_index

[16] Moodle. Quiz structure analysis and Discriminative efficiency. This statistic attempts to estimate how good the discrimination index is relative to the difficulty of the question. A 'good' question will score 50% or above. Retrieved on 6 December 2022 from https://docs.moodle.org/310/en/Quiz_statistics_report#Quiz_structure_analysis and https://docs.moodle.org/dev/Quiz_statistics_calculations#Discriminative_efficiency

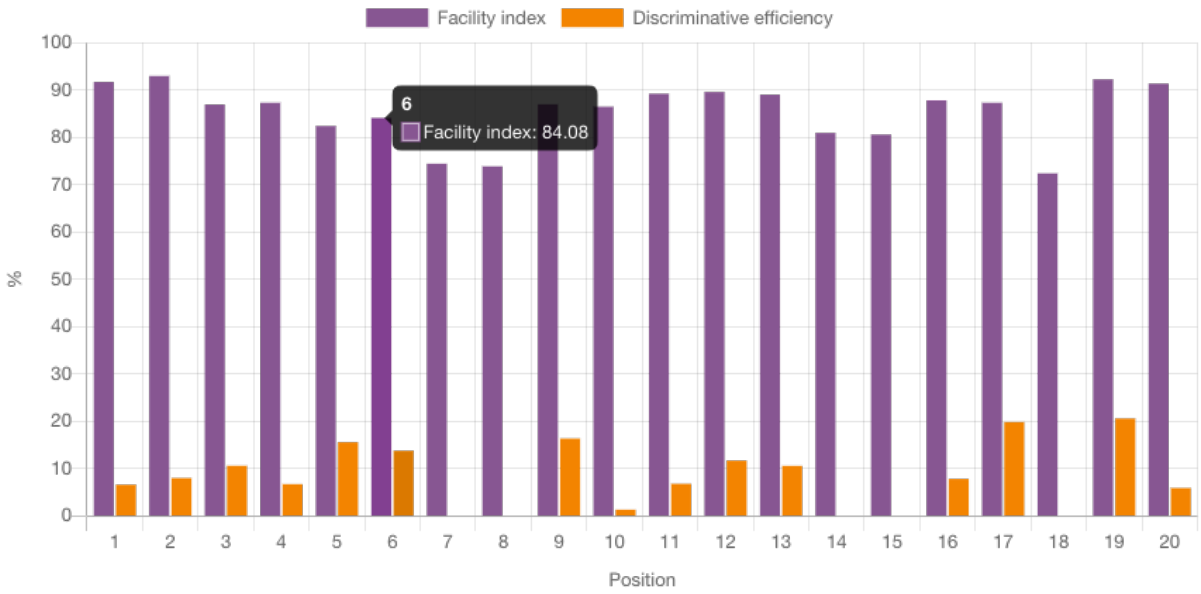

Fig. 22. Efficiency measurements for CPD Foundation (version 2) assessment.

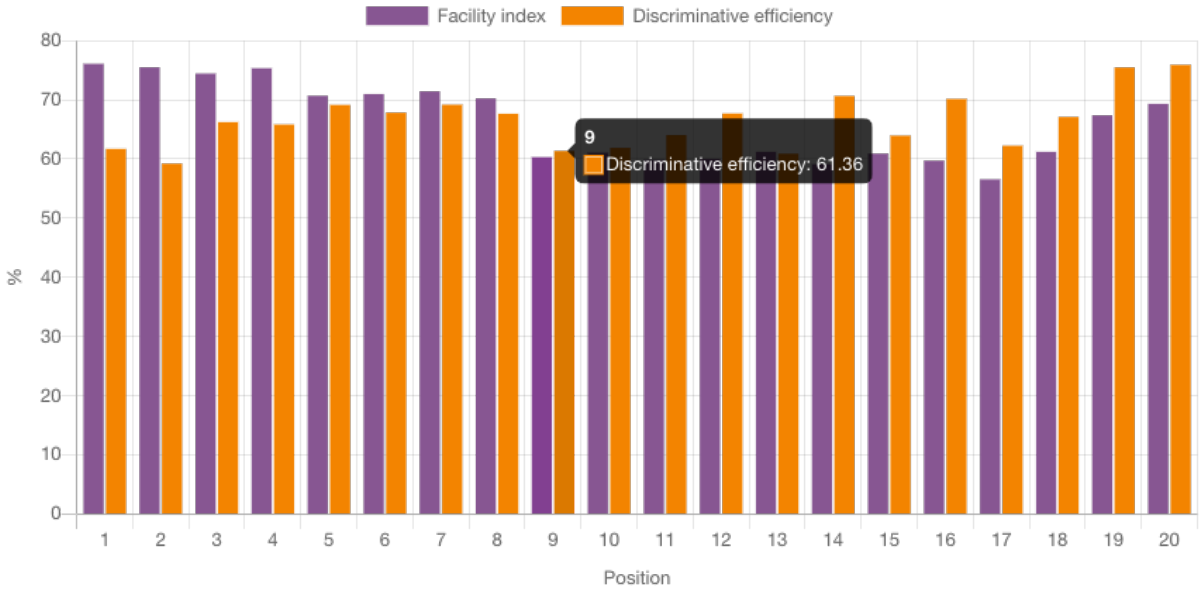

Fig. 23. Efficiency measurements for CPD Foundation (version 3) assessment.

CPD Practitioner assessment

Within version 3 of the CPD course, the Practitioner level assessment had two iterations: version A and version B. This is due to issues in version A with certain question types and some individual questions particularly towards the end of the assessment that were causing confusion for learners. Figure 24 highlights this challenge with low facility index scores for the final six questions of the assessment, based on 738 attempts. After working closely with a subject matter expert to reduce the number of available options and clarify specific questions, their usability improved and could be used within version B of the assessment. Although the questions are still difficult, their discrimination efficiency dramatically increased and now better correlate with the rest of the assessment questions, as shown in Fig. 25.

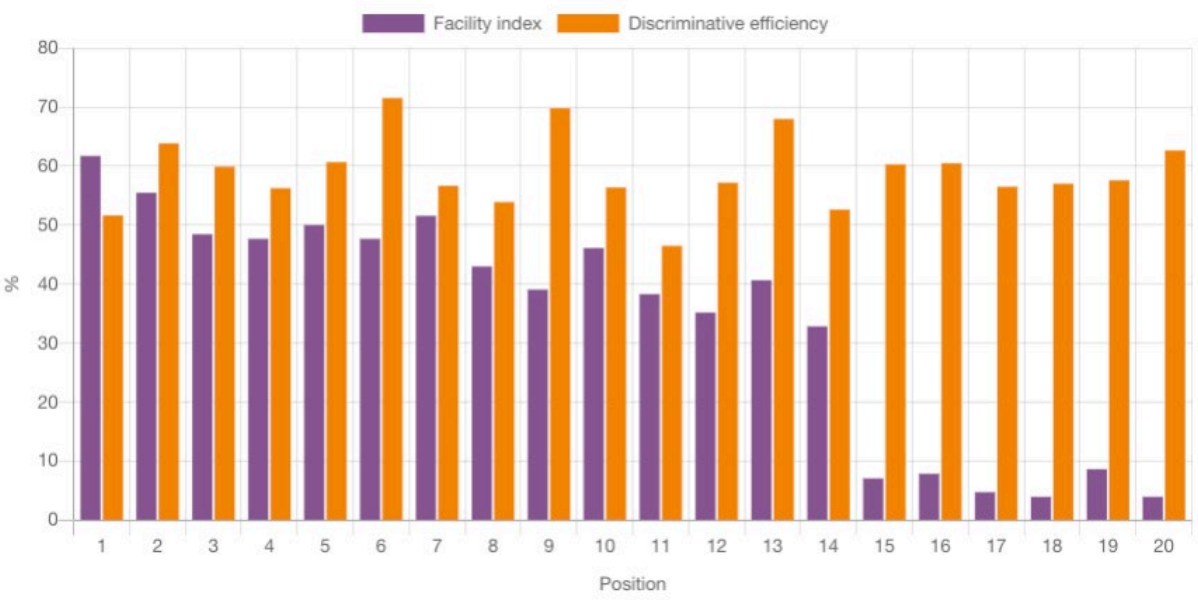

Fig. 24. Efficiency measurements for CPD Practitioner assessment version A.

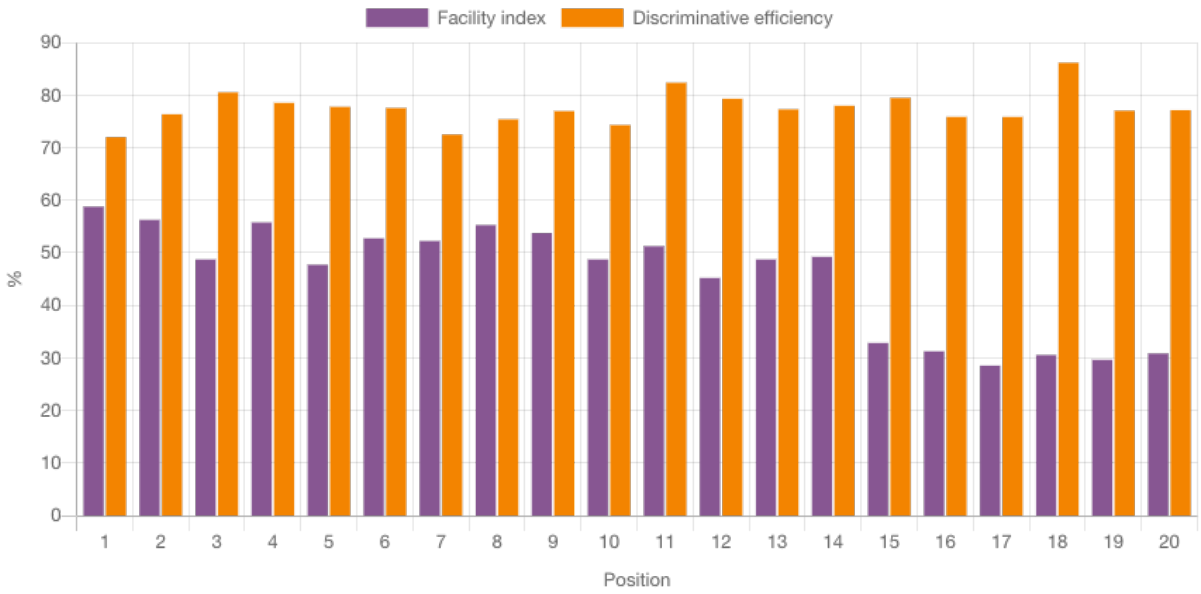

Fig. 25. Efficiency measurements for CPD Practitioner assessment version B.

Tier 6: Task competence

Impact of course information on learners' professional practice

Changes to professional practice

Of the key informants interviewed, 98% (n = 26) were in agricultural advisory roles. These learners confirmed they were able to enhance their knowledge, skills and decision-making ability in the field of diagnosing and making IPM-based recommendations while providing advice to farmers.

Informants in other roles such as researcher, consultant and students shared that the knowledge gained has helped to improve their confidence while training their staff, attending technical meetings, writing extension materials or conducting and planning their research. Some examples of notable changes are listed below.

- A **consultant from Rwanda** who provides services in agricultural extension shared that, after completing the courses in training other people in pest and disease management, he uses the knowledge gained in the development of extension materials.
- A **researcher from Rwanda** who is also a traditional export crops pathologist says he applied the skills used in the courses to go to rural areas and advise farmers.
- An **extension worker and a plant doctor from Rwanda** said that they were able to apply knowledge in the plant clinic when recommending or advising farmers about plant problems.
- A **private sector extensionist from Bolivia** shared that they have applied the knowledge acquired from the course in making the recommendations that are issued in the plant clinics, and she tries to make them comprehensive and recommend specific actions.
- A **private sector employee with an input supplier company in Bangladesh** said that he sells organic fertilizers and farmers ask him questions about their plant health problems. Through the course he learned how to diagnose some common problems and the "dos and don'ts" of providing comprehensive and practical management advice.

These unique individual changes to professional practices would suggest that, although the course materials are presented uniformly to all learners, the content has relevance to a variety of different learners in various roles. Key changes described by the key informants include their approach to diagnosis and management methodology, access to advisory resources, and increase in confidence when providing advice about pest diagnosis and management to farmers, which can lead to more informed application of agri-input products by farmers. While these findings are anecdotal, they demonstrate that knowledge gained from the CPD and CPM courses was successful in changing or informing professional practices for individuals in the target audience for these courses.

Tier 7: Transfer

Practical application of course learning and assessments in learners' work environment

Practical application of knowledge

Key informants who completed the CPD and/or CPM courses mentioned that they are applying the knowledge acquired from the courses in their work. Their responses also demonstrate that the diagnosis and management methodology from the courses are being converted into real-world skills and practices by learners. Some notable examples are described below.

- An **agricultural extension worker** from Bangladesh shared that the courses have changed his approach to providing advice to farmers. As an extension worker diagnosing multiple plant health issues, he is now able to take a systematic approach and can diagnose plant health problems effectively by following the CPD course methodology.
- An **agricultural extension worker and a plant doctor from Rwanda** shared that they applied the knowledge acquired from the diagnosis course to diagnose plant health issues, for example identifying bacterial wilt in a farmer's field.

- An **agricultural extension worker (private sector) from Bolivia** shared that the course really helped him to formulate more specific recommendations for pest management while advising farmers.

A summary list of other specific details about how learners were able to practically apply the methodology from the CPD and CPM courses is provided below.

- Improved ability to diagnose pests and diseases accurately and differentiate causes.
- Increased confidence in advising farmers with correct and timely recommendations.
- Better understanding of integrated pest management (IPM) and pest groups.
- Ability to recognize symptoms and identify issues more efficiently.
- More effective in minimizing farmers' losses through proper diagnosis and management.
- Enhanced knowledge in preventive methods and laboratory testing for viral diseases.
- Improved ability to diagnose nutrient deficiencies and soil-borne diseases.
- Greater clarity in recommending management strategies for different pest problems.

Building on the findings from Tier 6 on the changes to practice, this feedback demonstrates that learning from the courses is being used to improve engagement in the support of smallholder farmers. For many of the learners interviewed, it appears that the course helped to improve advisory confidence by providing clarity on the distinctions between the different symptoms caused by crop pests and diseases. Responses from the KIIs also suggest that the courses are helping to build on existing knowledge to improve professional practices.

It should be noted that the results may not be generalisable to a wider set of learners due to the sample size and the limitations of data generated by self-reporting. However, it does detail the ways in which the core diagnosis and management methodologies included in the course are being applied in practice within the work environment of learners from the target audience.

Tier 8: Effects of transfer

Learners sharing course knowledge with their communities

The CPD and CPM courses have been developed for learners in farmer advisory and academic roles, with a view to improving professional practices that help to support smallholder farmers and ultimately reduce crop loss. This means that the dissemination of information from these courses to wider communities is central to the aims and design of the courses. This dissemination will be more direct for those in extension and other advisory roles compared to those in academic roles, where dissemination may be indirect, for example by informing the development of agri-products or agricultural policy.

Information gathered from the KIIs and learner quotes included under Tiers 6 and 7 reveal that learners interviewed as part of this report feel that they are actively disseminating knowledge gained from this course to farmers and their wider communities.

> ***A researcher from Rwanda*** *who is also a traditional export crops pathologist says he applied the skills used in the courses in the field. He goes to rural areas to advise farmers, and they have increased their production, improved incomes, improved livelihoods and produce healthy produce. He applies IPM principles on the farm and teaches farmers to stop overusing pesticides. Finally, he trains them to consider IPM first and helps them to implement IPM.*

This feedback demonstrates how information from the courses is likely to form part of wider sources of information from experts in the field, all of which may inform wider communities about sustainable agricultural practices. A limitation of this finding is that it is not possible to assess the effectiveness or accuracy of this dissemination due to the scope of the data collected for this report. Therefore, it is recommended that assessment of the extent of transfer becomes a focus for future work and that additional research questions and methodologies are added for this tier of the L-TEM. Nevertheless, it is encouraging to see that the CPD and CPM courses are being used to inform professional practices and the methodology is being practically applied in the field.

Conclusions

Summary of findings

Table 4. Summary of findings.

Key issues	Key results
Barriers to enrolment and course completion	Key barriers for engaging with CABI Academy courses include language, sign-up and login processes, internet connectivity, and availability of time for independent study. However, there appears to be a strong desire from farmer advisors and students for the CPD and CPM courses and certifications because they fill an important need for pest and disease management. Measures are being taken to help learners overcome these barriers, such as financial contributions from organizations or countries to enable professional development of farmer advisory service providers.
Effect of promotional activities on learner enrolments	Although online promotional activities occurred during the COVID pandemic, recent in-person activities are considered to be more effective in increasing learner enrolments. This is noted by the high proportion of users who access the CABI Academy by directly inputting its URL.
Course reach of target learner demographics	Results show that the target age group of 18–57 in lower-income countries is being reached. Overall, similar numbers of men and women seemed to access the courses, though this depended on the country – with approximately twice as many men accessing the courses in Bangladesh compared to women. However, a significant proportion of users access the CABI Academy through mobile devices, highlighting the need to make the courses fully mobile responsive.
Participation behaviours as learners progress through the course activities	There is a predictable and expected decrease in participation as learners progress through the course modules. Furthermore, passing assessments to gain certification is important to learners as evidenced by trends in some learners retaking assessments until they pass. However, assessments are challenging with far more learners attempting the assessments than are successfully completing them.
Association between learner occupation and course participation	Most engagement with CABI Academy occurs with those coming from advisory roles, but this also varies across countries. Completion rates for both CPD and CPM are generally low, but students are more likely to be awarded the certification for passing the foundation assessment.
Value of course content to learners	Most learners who completed the course felt that they would be able to successfully apply the skills gained into their current role. They also felt that, except for the introduction modules, all the module contents were equally important in helping them complete the assessments.

Key issues	Key results
Validity and reliability of assessments	Based on Moodle data which provides statistical evidence of assessment attempts, important adjustments have been made to the Foundation and Practitioner assessments that has enabled improved reliability of the assessments. However, validity is reliant on the professional knowledge of our subject matter experts and thus requires further investigation.
Impact of course information on learners' professional practice	Key informant interviews, most of whom were in agricultural advisory roles, provided many examples of cases where learners have changed their professional practices as a result of the courses. Notable changes include their approach to diagnosis and management methodology, access to advisory resources, and increase in confidence when providing advice.
Practical application of course learning and assessments in learners' work environment	Key informants also provided examples when learners practically applied the learning from the courses in their work. The courses are helping learners to build on their existing knowledge and increase their confidence in providing advice such as by giving clarity on the distinctions between different symptoms caused by pests and diseases.
Learners sharing course knowledge with their communities	The information shared by those who engaged with the CABI Academy are likely to form part of wider sources of information for communities that will enable improvements and changes to crop pest diagnosis and management practices. However, the extent to which the courses have this impact of information transfer needs further research.

Key learning points

- The current courses and certifications are reaching their target audience in terms of age. However, although efforts are ongoing in the PlantwisePlus programme, additional efforts may be needed to engage more women in some countries such as Bangladesh where women are already underrepresented in the extension workforce (Mamun-ur-Rashid *et al.*, 2018).
- Future courses may need to be shorter, or broken into smaller pieces, in order to sustain learner engagement.
- In-person workshops with key influencers are highly effective at increasing take-up in a region.
- Language is a significant barrier, even when machine translation is available.
- Evidence from the key informant interviews and end-of-course questionnaires indicates that those who complete the courses are making good use of what they have learnt and bringing additional value to their communities.

Evaluation objectives

We have been able to meet many of the evaluation objectives set at the beginning of this exercise:

Short-term objectives

- Due to the continuous engagement with the learners during the evaluation process through survey results, interviews and focus group discussions, a lot of improvements were made to the assessments and course design to improve overall user experience. For example, improving signposting and navigation throughout the courses.
- Continuous monitoring of the assessment data has helped us review the level of difficulty of the Practitioner assessment and make changes to the Practitioner assessment questions.
- Several improvements were identified which will be implemented for future products (see Annex 6).

Long-term objectives

- The evaluation framework as well as processes and tools can be adapted for evaluating all CABI Academy products.
- The research questions and broader evaluation framework have been defined and tested through the CPD and CPM courses, and they can now be customized for new products.

Limitations of the study

The courses have not been live for long enough to reasonably establish and evaluate against some of the higher-level tiers of the L-TEM, such as assessing the success of the courses in achieving learning transfer. More specifically, the data for this evaluation were collected at the end of 2022, soon after the revisions of the Practitioner assessments of both courses were released. As such, more recent data, combined with targeted methods to assess the higher-level tiers, would likely provide new insights into the effectiveness of the courses.

Additionally, the quantitative data has limitations due to how user analytics data can or cannot be collected by Google Analytics (GA). Lastly, now that the research questions have been developed and defined in accordance with the evaluation framework, the interview questions for KIIs can be reformulated such that more focused questions can bring out necessary insights from learners and potential learners.

Suggestions for future research

Overcoming barriers

- The content being in English is a major challenge in non-English speaking countries as exemplified by our experiences in Latin America and across all countries. Whilst the machine-translated content may be good enough for a rapid rollout, it's important to validate these translations manually and override them where necessary. Of course, the cost of doing so should be compared with the benefits obtained such as by looking at whether there are enough potential users for a target language. The latter consideration is important because the return on investment for a full, manual translation may not be justified for a smaller user base.
- Investigation into overcoming context-specific, gender-related issues could be beneficial in increasing uptake. In particular, most users in Bangladesh were men, suggesting that women may have additional barriers in accessing and using the courses.
- Some learners faced issues while accessing the relevant courses and during the sign-up and login process. We recommend that the issues encountered are considered by upgrading to the latest version of Moodle, creating a new theme pack for the CABI Academy and simplifying processes wherever possible.

- There is a need to further explore how to increase course uptake. This may be through social media, paid advertising and in-country contacts, as well as making more use of the Skills Framework for Agriculture.
- With over 50% of users accessing the site via mobile phone or tablets, we must continue to optimize the experience for these users.

Patterns of use

- Are learners doing the assessments first and then using the course materials, or are they working through the course before attempting the assessments?
- Where are the 'pain points' in the user experience (Gibbons, 2021)? What can be done to minimize those pain points?

Motivation

- What is motivating people to enrol onto the courses and what motivates them to gain a certificate? How does this vary by country and demographics?
- How much value do learners gain from the Foundation and Practitioner certificates?
- Why are some people starting assessment attempts and not completing them or getting very low scores?
- How much value is gained by those who do not complete the courses?

Impact

- What objective data can we collect to measure whether the learning has been transferred to professional practice?
- How do the courses and assessments impact on the end-stakeholders (the farmers) and on the wider health and economic situation in the local area or the country?

Longitudinal

- How does usage and completion of online courses vary over time by country? What are the factors that influence usage and completion?
- Can we correlate marketing and communication campaigns with increased take-up?

Acknowledgements

This research was funded by the CABI-led PlantwisePlus programme, which is financially supported by the Directorate-General for International Cooperation, Netherlands (DGIS); European Commission Directorate General for International Partnerships (INTPA); UK International Development from the UK government; and the Swiss Agency for Development and Cooperation (SDC).

CABI as an international intergovernmental not-for-profit organization, gratefully acknowledges the generous support received from our many donors, sponsors and partners. In particular we thank our Member Countries for their vital financial and strategic contributions.

References

A4AI (Alliance for Affordable Internet) (2021) *The Affordability Report 2021*. Web Foundation.

Betthäuser, B.A., Bach-Mortensen, A.M. and Engzell, P. (2023) A systematic review and meta-analysis of the evidence on learning during the COVID-19 pandemic. *Nature Human Behaviour* 7, 375–385. https://doi.org/10.1038/s41562-022-01506-4

CABI (2018) PestSmart Diagnostics elearning [promotional flyer]. CABI. https://assets.e-agriculture.fao.org/public/news/PestSmart%20Promo%20Flyer2%20(002).pdf (accessed 12 June 2025).

CABI (2022) PlantwisePlus Annual Report 2021. CABI. https://www.cabi.org/cabi-publications/plantwiseplus-annual-report-2021/ (accessed 10 October 2022).

CABI Academy (2024) Free Access Countries. https://academy.cabi.org/mod/page/view.php?id=12664 (accessed 15 June 2025).

Chen, G., Davis, D., Hauff, C. and Houben, G.J. (2016, April). Learning transfer: Does it take place in MOOCs? An investigation into the uptake of functional programming in practice. In *Proceedings of the Third (2016) ACM Conference on Learning@ Scale*, pp. 409–418.

Christensen, G., Steinmetz, A., Alcorn, B., Bennett, A., Woods, D. and Emanuel, E. (2013) The MOOC Phenomenon: Who Takes Massive Open Online Courses and Why? http://dx.doi.org/10.2139/ssrn.2350964

Gibbons, S. (2021) Three levels of pain points in customer experience. Nielsen Norman Group. https://www.nngroup.com/articles/pain-points/ (accessed 6 December 2022).

Groupe Speciale Mobile Association (2021) *Connected Women: The Mobile Gender Gap Report 2021*. GSMA. https://www.gsma.com/r/wp-content/uploads/2021/07/The-Mobile-Gender-Gap- Report-2021.pdf (accessed 6 December 2022).

Grover, S., Franz, P., Schneider, E. and Pea, R. (2013) The MOOC as distributed intelligence: Dimensions of a framework & evaluation of MOOCs. *Proceedings CSCL*, pp. 42–45.

IFC (International Finance Corporation) (2022) Executive Summary - Online Learning - Reaching Women in Emerging Markets. https://www.ifc.org/en/insights-reports/2022/women-and-online-learning-in-emerging-markets (accessed 6 December 2022).

Ishii-Adajar, H., Cameron, K., Palmer, C., Li, A., Kadzamira, M., Fleming, S., Thakur, M. and Ogunmodede, A. (2024) A review of CABI digital tools for plant health and pest risk management. *Journal of Agricultural & Food Information* 25(1–4), 3–24. https://doi.org/10.1080/10496505.2025.2467731

ITU (International Telecommunication Union) (2021) *Measuring digital development: Facts and Figures 2021*. Measuring digital development - Facts and figures 2021 (itu.int) (accessed 6 December 2022).

Jordan, K. (2014) Initial trends in enrolment and completion of massive open online courses. *The International Review of Research in Open and Distributed Learning* 15(1), 133–160. http://oro.open.ac.uk/39592/

Jordan, K. (2015) Massive open online course completion rates revisited: assessment, length and attrition. *International Review of Research in Open and Distributed Learning* 16(3), 341–358. https://doi.org/10.19173/irrodl.v16i3.2112

Kennedy, E. and Laurillard, D. (2019) *A MOOC Value Creation Methodology*. London: UCL Institute of Education. https://www.researchcghe.org/perch/resources/view-the-presentation-2.pdf (accessed 6 December 2022).

Kirkpatrick, D. (1996) Revisiting Kirkpatrick's four-level-model. *Training & Development* 50(1), 54–57.

Lan, M. and Hew, K.F. (2020) Examining learning engagement in MOOCs: a self-determination theoretical perspective using mixed method*. International Journal of Educational Technology in Higher Education* 17, 7, 24 pp. https://doi.org/10.1186/s41239-020-0179-5

Mamun-ur-Rashid, Md., Kamruzzaman, M. and Mustafa, E. (2018) Women participation in agricultural extension services in Bangladesh: current status, prospects and challenges. *Bangladesh Journal of Extension Education* 29, 93–107.

Milligan, C. and Littlejohn, A. (2017) Why study on a MOOC? The motives of students and professionals. *International Review of Research in Open and Distributed Learning* 18(2), 92–102. https://id.erudit.org/iderudit/1066134ar

Neelen, M. and Kirschner, P.A. (2020) Evidence-informed learning design: Creating training to improve performance. Kogan Page. https://www.koganpage.com/hr-learning-development/evidence-informed-learning-design-9781789661415

Oluwatayo, J.A. (2012) Validity and reliability issues in educational research. *Journal of Educational and Social Research* 2(2), 391–400, DOI:10.5901/jesr.2012.v2n2.391

Paudel, P. (2021) Online education: benefits, challenges and strategies during and after COVID-19 in higher education. *International Journal on Studies in Education* 3(2), 70–85. https://doi.org/10.46328/ijonse.32

RE-AIM. *Evaluation model.* http://www.re-aim.org/about/what-is-re-aim/ (accessed 6 December 2022).

Thalheimer, W. (2016) Performance-Focused Smile Sheets: A radical rethinking of a dangerous art form. Work-Learning. https://openlibrary.org/books/OL47324474M/Performance-Focused_Smile_Sheets

Thalheimer, W. (2018) The learning-transfer evaluation model: Sending messages to enable learning effectiveness. https://WorkLearning.com/Catalog (accessed 6 December 2022).

Wenger, E., Trayner, B. and Laat, M.D. (2011) Promoting and assessing value creation in communities and networks: a conceptual framework. Open Universiteit, Ruud de Moor Centrum Rapporten. http://wenger-trayner.com/documents/Wenger_Trayner_DeLaat_Value_creation.pdf

World Bank (2021) *Remote learning during COVID-19: Lessons from today, principles for tomorrow*. https://documents1.worldbank.org/curated/en/160271637074230077/pdf/Remote-Learning-During-COVID-19-Lessons-from-Today-Principles-for-Tomorrow.pdf

Zhao, Y., Sánchez-Gómez, M.C., Pinto-Llorente, A.M. and Sánchez Prieto, R. (2025) Adapting to crisis and unveiling the digital shift: a systematic literature review of digital competence in education related to COVID-19. *Frontiers in Education* 10, 1541475, 15 pp. https://doi.org/10.3389/feduc.2025.1541475

Annexes

Annex 1: Selecting an evaluation framework

The CABI Academy courses sit outside of any formal curriculum, so the evaluation approach is not restricted to a specific framework or set of regulated standards. Multiple frameworks were considered and assessed based on the proposed aims of the evaluation, the context of the courses (continued professional development) and the delivery method (online, self-paced, self-study courses). The evaluation methods considered are described below.

Case study evaluation models

Case study models offer in-depth analysis of specific courses. Taking a distributed intelligence case study approach evaluates courses from the perspectives of multiple contributors and stakeholders. This approach also utilizes data analytics from the course to provide a more complete picture of its educational impact (Grover *et al.*, 2013). The Value Creation Framework is another case study-, cycle-based approach, specific to the evaluation of continued professional development-related courses (Wenger *et al.*, 2011; Kennedy and Laurillard, 2019). This model focuses on how learning gained from participating in an online course creates value beyond the individual, reaching wider communities and networks.

These models are both highly relevant to the evaluation of the CPD and CPM courses as they both transfer well to evaluating courses with a continued professional development focus. As this evaluation aims to evaluate two specific and well-established courses in our portfolio, they are also highly relevant to the context of this report. Whilst elements of these approaches can be incorporated into our approach to evaluation, after consideration, the case-study approach was felt to lack the ability to provide scalability for future course evaluations.

Repurposed evaluation frameworks

Multiple-stage hierarchical-based models were also considered as being relevant to the aims of this evaluation. Relevant frameworks included the Kirkpatrick model (Kirkpatrick, 1996), RE-AIM[17] and the Learning-Transfer Evaluation model (L-TEM) (Thalheimer, 2018). The Kirkpatrick model was originally designed to evaluate face-to-face training programmes and focuses on the educational attainment of learners by assessing participant reaction, learning, behaviour and results (see Fig. A1).

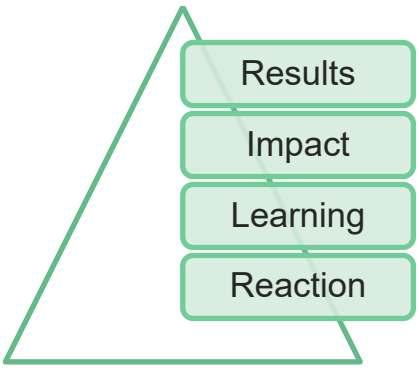

Fig. A1. Kirkpatrick model.

[17] RE-AIM. Evaluation model. Retrieved on 6 December 2022 from http://www.re-aim.org/about/what-is-re-aim/

Although there is no formal requirement to publish MOOC evaluations, the Kirkpatrick model is regularly cited in the literature as a basis for many MOOC evaluations. With its simple four-stage approach, it provides a useful structure to measure not only the learning that has taken place, but also how this learning leads to wider results (Thalheimer, 2018). However, it has also been criticized for emphasizing the value of learner perceptions and how these perceptions link directly to learning and results. Linking learner perceptions to learning results is not supported by evidence and has in fact been disproven, and so these models, whilst helpful, should be treated with caution (Thalheimer, 2018; Neelen and Kirschner, 2020).

The RE-AIM model also approaches evaluation in a series of stages. These stages include Reach, Effectiveness, Adoption, Implementation and Maintenance (RE-AIM), and was originally designed for assessing training in a medical context. This model is similar to the Kirkpatrick framework but encompasses more nuance in the different levels it includes. As with the Kirkpatrick model however, RE-AIM has not been designed to work with the scale of an online environment, and with the self-study model used for the CPD and CPM courses, and so are limited in their applicability to some of the more fundamental characteristics of the online learning context.

Learning-Transfer Evaluation Model (L-TEM)

The Learning-Transfer Evaluation Model (L-TEM) by Thalheimer (2018) focuses on continued professional development and the application of real-world skills to wider communities and environments. The L-TEM is an adaptation and evolution of the Kirkpatrick model in so far as it takes a tiered approach but does not treat all tiers as having equal value for the different methods used to assess the impact of training on learning.

The L-TEM consists of eight tiers. The tiers are colour-coded, with red indicating a low level of value attributed to the method of data in providing evidence of learning transfer (tiers 1 and 2), although they are still likely to hold value for other evaluation purposes. Yellow indicates mediocre methods for assessing learning transfer (tiers 3 and 4) and green indicates good or useful evaluation methods (tiers 5–8) (Thalheimer, 2018).

This framework has been considered by the evaluation team as the most relevant model to use as the structure for evaluation in this report, due to the alignment of the L-TEM's emphasis on transfer of knowledge to real-world situations to the core aims of the CPD and CPM courses. The tiers also take the digital learning context into account and offer critical responses to the value of the associated data. Its robust approach also offers the ability for the framework to be replicated and scaled for the evaluation of future CABI Academy courses.

Annex 2: Implementation timeframe

Table A1. Implementation timeframe for CABI Academy evaluation.

Activities	2022											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Evaluation Planning Activities												
Planning evaluation structure and breakdown of activities and drafting the framework document												
Attendance												
Define a report (What data exists and what needs to be gathered? What outputs are required?)												
Develop various Moodle reports												
Testing the reports												
Analysing and writing up the report												
Additional analysis												
Activity												
Design CPD and CPM end-of-course questionnaires, review and update the questionnaires and add Google Analytics on CABI Analytics dashboard for easier viewing and analysis												
Write up												
Review												
Learner Perceptions												
Reviewing the end-of-course questionnaires												
Designing the KII questionnaire and tool												
Review the tool												
Translation												
Training on KII implementation to regional teams												
Conduct KIIs (via in-country resources)												
Analysis and write-up												
Knowledge												
Share and run the follow-up assessments												
Analysis and write-up												
Decision- making Competence												
Analysis and report write-up												

Annex 3: End-of-course questionnaire

1. Are you able to apply what you've learned from this course and/or assessment in your current job role? Select the answer that most applies to you.
    a. It's not possible to use what I have learned in my current role.
        i. (If 1a selected) Why is it not possible to apply skills from this course to your job role? (Free text)
    b. I need more guidance to be able to practice what I have learned.
        i. (If 1b selected) What type of additional guidance or resources would help you to incorporate what you have learned into your job role? (Free text)
    c. I have been able to successfully apply the skills gained into my current role.
        i. (If 1c selected) How have you/ how are you planning to apply the skills you have gained into your professional practice? (Free text)
2. Did you use the course learning modules to help you complete the assessment part of this product?
    a. Yes
        i. (If 2a selected) Which of the following modules did you use to help you complete the assessment? Select as many as are relevant from the list.
            1. [List of course modules]
    b. No
        i. (If 2b selected) Without having used the learning modules, did the assessment include questions that were unclear or not relevant to you?
3. How would you rate this course out of five? Enter a value between 1–5 (1 = the course has no value or relevance to you and your job role, up to 5 = it is highly valuable and applicable to your job) (1–5).
4. Would you recommend this digital learning product to a colleague?
    a. Yes
        i. (If 4a selected) When recommending this digital learning product to a colleague, how would you describe it to them? (Free text)
    b. No
5. Thank you for your valuable feedback, your answers will help us to make improvements. Before you go, is there anything else you would like to tell us about your experience of participating in this course or the assessments? (Free text)
6. I consent to being contacted by a member of the CABI Academy team to help provide additional information for the purposes of evaluating the course.
    a. Yes
    b. No

Annex 4: Focus group discussion (Bangladesh)

- Undergraduate and graduate students (8)
- Agricultural extension workers (4)

Q. How did you find out about the course?

- CABI staff
- via email
- via colleagues
- WhatsApp group
- Facebook group

Q. What were your expectations of doing the course?

- Gain knowledge and upskill themselves in order to train their junior staff (4)
- Learn about the main pests and diseases that affect crops (2)
- Learn more about the behaviour and symptoms of pests to use the appropriate strategies for their control (2)
- Expand knowledge on comprehensive crop management practices and technologies (3)
- To be more familiar with pest management and mainly diagnosis; to improve knowledge in the area of plant protection (2)
- To learn about the key signs and symptoms of pests and diseases, to differentiate them as some of them can be confusing (3)
- How to advise farmers. Learn IPM for all pests and disease (2)
- Learn how to use chemicals and what chemicals are appropriate for which disease, how to choose (2)
- From CPD, wanted to learn diagnosing all pests and diseases which we encountered in the field
- To help farmers through knowledge gained on crop pests and diseases and to increase production

Q. Do you like completely online or completely offline courses or partially online and offline courses? Do you have time for completely offline courses?

- 95% of the interviewees having advisory roles were happy with the online course. A key informant from Rwanda mentioned that online learning is good for short courses but face-to-face is better for long courses.
- 80% of the interviewees from Bangladesh shared that partly online and partly offline courses would be good as they don't have lot of time for completely offline courses. They thought that not all the plant protection content can be learned online and can be included or taught via the online modules. Face-to-face expert sessions would help to understand those issues in depth via discussion.
- Interviewees from the students group thought that they have had enough of field courses and having an online course is good enough to get a certificate and to add to their curriculum vitae.

Q. Which other courses would you like to see on CABI Academy?

- Include identification & management of weeds and parasitic plants under CPD and CPM (2)
- Plant physiology related to the attack of pests and diseases
- Course on breeding protocols for different natural enemies: parasitoids and predators

- Courses related to biological pest control or plant physiology related to the attack of pests and diseases
- Biological control (5)
- Biological pest control, specifically with microbial biotechnology
- Courses more focused on entomology
- Include information on spicy vegetables, calculations on balancing production and revenue through agricultural activities
- Courses on cereals, legumes and vegetables production, seed multiplication, available chemical products in certain regions
- Identify and differentiate nutritional deficiencies in plants from the symptoms caused by pests
- Plant nutrition management according to crop-specific requirements
- Add content for some parasitic plant issues in agriculture (*Cuscuta*, *Striga* and *Orobanche* etc.) such as dodder in the field; their identification and management and also weeds-identification and management
- Research technologies and statistics
- Horticultural course/new horticultural technologies (5)
- Organic farming (4)
- Integrated Pest Management (4)
- Add pest and disease problems for more crops relevant to Bangladesh; crops grown internally like apple, mulberry, cotton, cassava is not known to Bangladesh (12)
- Able to minimize farmers' losses through pest/disease identification and management
- Acquired knowledge on symptoms of viruses, soil borne diseases, symptoms and how to check nutrient deficient symptoms (3)

Q. Are you able to apply the skills/knowledge acquired from the courses

- A **consultant** from Rwanda who provides consultancy services in agricultural extension shared that he uses the knowledge in training other people in pest and disease management and development of extension materials
- A **researcher** from Rwanda who is also a traditional export crops pathologist says he applied the skills from the courses in the field. He goes to rural areas to advise farmers. They have increased their production, improved incomes, improved livelihoods and produced healthy produce. IPM: Applied in farm, teaches farmers to stop using too many pesticides. Trains them to consider IPM first. Helps farmers to implement IPM
- An **extension worker and a plant doctor from Rwanda:** Able to apply knowledge in plant clinic when recommending or advising farmers about plant problems
- Knowledge gained through the course: the knowledge checks improved knowledge in detecting pests and diseases, it was like a game and not difficult at all to answer checks once you go through the course. Gained experience in going through other online courses
- Applies the knowledge daily from the courses. As an extensionist, he applies diagnosis and management skills. He has learnt to calculate the risks before advising farmers on right time to plant, estimates risk of managing fungus in cases where planting time has not been observed, is able to estimate whether a farmer will likely make losses or profits from managing crop pests and diseases
- A **private sector extensionist from Bolivia** shares that they have applied the knowledge acquired from the course in making the recommendations that are issued in the plant clinics; she tries to make them comprehensive and recommend specific actions
- A **private sector employee with an input supplier company in Bangladesh:** CABI Academy online courses are helpful in providing opportunity to learn at any time. Having

less grades, he was not able to complete his degree in plant protection but the CABI Academy has provided him opportunity to learn more during free time on his mobile

- A **private extension worker** shares that they have applied the knowledge acquired from the course in making the recommendations that are issued in the plant clinics; she tries to make them comprehensive and recommend specific actions
- A **university teacher** shares that he learnt new ways to guide their students effectively

Q. Is decision-making ability to advise farmers or doing any particular task in their work enhanced, due to taking this course?

- An **agricultural extension worker from Bangladesh** shares that the courses have changed his approach of providing advice to farmers. Now he takes a systematic approach while investigating any plant health problems. As an extension worker they have to diagnose multiple plant health issues and now he is able to diagnose by the process of elimination of various problems and provide proper diagnoses
- An **agricultural extension worker and a plant doctor from Rwanda** share that they applied the knowledge acquired from the diagnosis course to diagnose plant health issues for example identifying bacterial wilt in farmer fields
- An **agricultural extension worker (private sector), Bolivia: "**The course helped a lot to formulate more specific recommendations for pest management. The support material greatly enriches the knowledge acquired"
- "Enhanced my knowledge in preventive methods, diagnosis and acting"
- "Normally, diagnosis is complicated. Some symptoms look similar for several pests." His knowledge in diagnosis is now better, especially in differentiating between the problem and cause of problem, and the management options
- In meetings she is confident to give advice and speak about pests and diseases with authority
- Knowledge on diagnosing crop pests and diseases
- Now offers advice in managing viral disease by conducting laboratory tests, when they are confident, they have diagnosed a disease properly
- "Helps us to give farmers right advice at the right time"
- Able to give better advice than before

Annex 5: Key Informant interview questionnaire

Country of KII

- Bangladesh
- Rwanda
- Burkina Faso
- Bolivia

Role of the learner

- Regulator
- Extension worker (private)/Extension worker (government)
- University Teacher
- University Student
- Agro-input supplier
- Administrative
- Researcher
- NGO staff

Note: these can be merged if we don't get any of these roles

Personal information

- Name, role, designation and organization
- Age (tick from the below age ranges)
  - 18–24
  - 25–34
  - 35–44
  - 45–54
  - 55–64
  - 65+
- Gender
- Location where based
- Education level
- How did you find about the course?

Objective of doing the course

- What were your expectations of doing the course?
- Were your expectations met overall?
- What do you think is the most valuable thing you've learned?

About the courses

- Which courses have you attempted on CABI Academy?
- Which ones did you like doing?
- Is there anything (content) you thought should be included in CPD/CPM courses?
- Did you find courses easy or difficult?
- Which other courses would you like to see on CABI Academy?

Course content

- Were you able to sign up & login to the site without any issues?

- How easy or difficult was it to navigate around the course and course materials? e.g., going back in to pick up where you left off
- Was it always clear what you were being asked to do or what you have to do next?
- Was the language of the content clear and easy to understand?
- How useful were the knowledge checks?
- Did you complete the Foundation assessment? At what point?
- How many days and attempts you took to pass?
- Did you take the assessment first before going through the content or after going through the course modules?
- Were you aware during the course that the Foundation assessment can be taken without going through the course materials?

Experience

- How was your overall experience of working through the course?
- What was the best thing?
- Did you face any problems or difficulties? (regarding navigation, content, knowledge checks, access to the CABI Academy site)

Language of the course

- Was the language of the course at the right level for you? Do you think you were comfortable in taking the course in English?
- Have you seen the translations on the course? Were the translations in Kinyarwanda/Bangla/French/Spanish good enough for you?

Course fee for this course

- Currently the course is free to use for your country, if it had been a paid course how much do you think you would have paid to do this? (local currency)

Certificate award

- Have you taken this course for being awarded with a certificate or just for enriching your knowledge/learning?
- If answered “certificate”: Why is a certificate important to you?

Other similar courses

- Do you think there are such other online courses in crop protection like these CABI Academy courses? If yes, name them.
- Do you like completely online or completely offline courses or partially online and offline courses? Do you have time for completely offline courses?

Skill level of the user

- Mark the skill level of the learner (as Foundation/Practitioner/Advanced) based on the following descriptions
    - Foundation: Someone who is an early stage in their career and works under supervision
    - Practitioner: Someone who can work without supervision
    - Advanced: Someone who leads and provides direction

Learning from the course

(for learners who completed the course in 2020/2021) to measure their increase in knowledge or change in behaviour, attitude)

- What skills/knowledge have you acquired from the course/s?
- Were you able to apply your skills/knowledge acquired from the course in your work?
    - If yes-How are you using it in your work?
- Do you think your decision-making ability to advise farmers or doing any particular task in your work has enhanced, due to taking this course?
    - If yes, then how?

Annex 6: Summary of Key Informant interviews

Country	Role (No. of interviewees)	Education	Age group (years)
Bangladesh (12)	Agricultural extension workers (government) (4)	Bachelor's and Master's degree	35–44
	Agricultural extension workers (private) (3)	Master's degree in environmental science and MSc plant pathology	35–44
	University students (4)	Bachelor's and Master's degree	19–22
	University teacher (1)	PhD	35–44
Rwanda (5)	Researcher (1)	Master's degree	45–54
	Agricultural extension-field officers (private) (agronomist) (2)	Bachelor's degree in irrigation	35–44 25–34
	Agricultural extension field officer (government) (1)	Bachelor's degree in horticulture	35–44
	Consultant (1)	Bachelor's degree in crop production	45–54
Bolivia (9)	Agricultural extension workers (private) (2)	Master's degree	55–64
	NGO staff (1)	Master's degree	35–44
	Agricultural extension workers (government) (4)	Bachelor's degree Master's degree	25–34;35–44;55–64
	Researcher (1)	Bachelor's degree	45–54
	University teacher (1)	Master's degree	45–54

Annex 7: Suggestions for improvements

We have identified below several suggestions for improvement from the interviews and end-of-course questionnaire. However, in deciding whether to implement these suggestions, CABI must consider the impact they will have on other users, and on whether it is financially viable. The numbers in brackets indicate the number of times this recommendation was made during 2022.

Visual/learning design

Suggestion	Issues to consider
Videos of insects, mites and various other symptoms would be more helpful (6) More pictures and videos should be included to explain diagnosis of the pest and diseases (13)	We need to bear in mind that many people will not have sufficient bandwidth or data to access videos Videos are expensive to produce and to maintain
Add more images for better understanding in modules 3 and 4. It will help in remembering the symptoms and causes	We would need to understand where images would provide the most benefit
All the knowledge check questions should appear on the same page (2)	This would cause problems for people on low bandwidth connections, especially where the questions have many images

Usability

Suggestion	Issues to consider
Should be able to start from the page where last left off	We are looking into how we can indicate progress better. Unfortunately, the platform doesn't yet allow us to remember the last place

Course language

Suggestion	Issues to consider
The course should be in local language of the learner (5)	We can offer many languages through machine translation. Manual translation by subject matter experts is extremely expensive

Course content

Suggestion	Issues to consider
Local crops, pest and diseases of the respective country should be included (4)	The CPD and CPM courses are designed to be globally generic; focused on the general methodology We are open to creating locally-specific add-ons to the courses and certifications, subject to funding being available

Others

Suggestion	Issues to consider
Add other courses for agriculturists viz, statistical analysis, research tools to improve our skills	We are building out our catalogue of courses relevant to people who advise farmers. Subject to funding we may extend that to other audiences
Reduce the assessment pass mark to 70%	Given that learners can attempt the assessments as many times as they wish, we believe 80% is a good balance between making them too easy, and too difficult

Contact CABI

Africa

Kenya
CABI, Canary Bird
673 Limuru Road, Muthaiga
PO Box 633-00621
Nairobi, Kenya
T: +254 (0)20 2271000 / 20
E: africa@cabi.org

Ghana
CABI, CSIR Campus
No. 6 Agostino Neto Road
Airport Residential Area
P. O. Box CT 8630, Cantonments
Accra, Ghana
T: +233 (0)302 797 202
E: westafrica@cabi.org

Zambia
CABI, Southern Africa Centre
5834 Mwange Close
Kalundu
P.O. Box 37589
Lusaka, Zambia
T: +260 967 619 665
E: southernafrica@cabi.org

Americas

Brazil
CABI, UNESP-Fazenda Experimental
Lageado, FEPAF (Escritorio da CABI)
Rua Dr. Jose Barbosa de Barros 1780
Fazenda Experimental Lageado
CEP:18.610-307
Botucatu, São Paulo, Brazil
T: +55 (14) 3880 7670
E: y.colmenarez@cabi.org

Trinidad & Tobago
CABI, 59 Gordon Street, St Augustine
Tunapuna 331323
Trinidad and Tobago
T: +1 868 6457628
E: caribbeanLA@cabi.org

USA
CABI, 6 Liberty Square #2775
Boston, MA 02109, USA
T: +1 (617) 682-9015
E: h.jansen@cabi.org

Asia

China
CABI, Beijing Representative Office
Internal Post Box 85
Chinese Academy of Agricultural Sciences
12 Zhongguancun Nandajie
Beijing 100081, China
T: +86 (0)10 82105692
E: china@cabi.org

India
CABI, 2nd Floor, CG Block,
NASC Complex, DP Shastri Marg
New Delhi – 110012, India
T: +91 (0)11 25841906
E: india@cabi.org

Malaysia
CABI, Building A19
MARDI, 43400 Serdang
Selangor, Malaysia
T: +60 (0) 3 89432921
E: cabisea@cabi.org

Pakistan
CABI, Opposite 1-A,
Data Gunj Baksh Road
Satellite Town, PO Box 8
Rawalpindi, Pakistan
T: +92 51 9292062
T: +92 51 8434979
E: cabi.cwa@cabi.org

Europe

Switzerland
CABI, Rue des Grillons 1
CH-2800 Delémont, Switzerland
T: +41 (0)32 4214870
E: europe-CH@cabi.org

UK
CABI, Nosworthy Way
Wallingford, Oxfordshire, OX10 8DE, UK
T: +44 (0)1491 832111
E: corporate@cabi.org

CABI, Silwood Park, Buckhurst Road,
Ascot, Berkshire, SL5 7PY, UK
T: +44 (0)1491 829080
E: cabieurope-uk@cabi.org
E: microbialservices@cabi.org