

Bridging a University and Its Partner Schools in Chemistry Education: A Practice-Based Account of Managing and Evaluating a Knowledge Transfer Programme in Malaysia

Muhd Ibrahim Muhamad Damanhuri^{1,2*}, Alfirah Ahmad¹, Raashini Manimaran¹, Saib Haikal Saufi¹, Mahkrus Agam Mohd Subhan¹

¹Faculty of Science and Mathematics, Sultan Idris Education University, 35900 Tanjong Malim, Perak, Malaysia

²STEM Nurturing Centre, Sultan Idris Education University, 35900 Tanjong Malim, Perak, Malaysia

*Corresponding Author

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ABSTRACT

University–community knowledge transfer programmes offer universities a practical means of bridging research and classroom practice by supporting school teachers, yet accounts of how such programmes are managed and how well they work remain limited. This article shares a university programme team's experience of planning, delivering, and evaluating a three-day chemistry education knowledge transfer programme implemented in October 2025 in partnership with a district education authority in Malaysia. The team developed four teacher-guide modules (Modules A–D) integrating inquiry-based, contextual, and cooperative approaches, delivered them to teachers and students, and evaluated their usability with teachers ($n = 15$). Teachers rated the modules highly for usefulness, ease of use, ease of learning, and satisfaction (means 4.45–4.62 on a five-point scale). The programme was delivered as scheduled to 15 teachers and 90 students, three times its student target, although the larger group stretched facilitators and materials. Effectiveness is judged here by teacher-perceived usability; student learning was not measured. The team's experience offers practical lessons on documenting design decisions, retaining evaluation data, and agreeing participant numbers with partners in advance.

Keywords: knowledge transfer; university–school partnership; chemistry education; teacher-guide modules; programme evaluation; CIPP model

INTRODUCTION

Secondary chemistry requires students to move between observable phenomena, submicroscopic models of particles, and symbolic representations, a demand that is still widely recognised as a major source of difficulty in learning the subject (Talanquer, 2022). Research has responded with a broad range of student-centred pedagogies. Inquiry-based, context-based, and cooperative approaches have each developed substantial research bases (Demelash et al., 2023; Güngör et al., 2026; Jegstad, 2024), and a meta-analysis of high school chemistry pedagogies reported generally positive effects on student learning (Ahmad et al., 2023), although the methodological quality of this evidence varies (Jegstad, 2024). For practice, then, the question is not so much whether such approaches exist as how teachers can be supported to use them.

This support matters because it is teachers who put pedagogical innovation into practice. A systematic review of inquiry-based science education in pre-service teacher education reported that, after learning about inquiry in campus-based courses, pre-service teachers faced challenges in implementing it during school placements (Strat et al., 2024). The availability of research does not automatically translate into classroom practice;

teachers may require structured materials, topic-specific guidance, and opportunities to see approaches enacted.

Universities can help bridge this gap through knowledge transfer and community engagement programmes in which academic staff and students work with schools and education authorities. The programme examined here was short, modestly resourced, and documented mainly through institutional reports, and it pursued several purposes at once: supporting teachers, engaging school students, and developing the university's own pre-service teachers. These features make such programmes practically attractive, but they also make them difficult to evaluate rigorously.

Implementation research distinguishes how well a programme is delivered and received from what it achieves for its intended beneficiaries (Damschroder et al., 2022; Proctor et al., 2023). This distinction is important for educational knowledge transfer: favourable teacher perceptions of a module suggest that it may be adopted, not that it improves learning. Comprehensive evaluation frameworks such as the CIPP model (Stufflebeam, 2003) offer one means of examining how a programme's context, design resources, delivery, and outputs relate to one another.

In the literature reviewed here, research on chemistry pedagogy focuses mainly on the effects of specific approaches on student outcomes (Ahmad et al., 2023; Jegstad, 2024), whereas work on partnerships and implementation is largely situated outside chemistry education (Damschroder et al., 2022; Proctor et al., 2023; Sarmiento-Márquez et al., 2023). Single-case accounts that jointly examine how modules developed for a programme were perceived by teachers and how the programme was managed are therefore scarce, particularly for short programmes reported by the teams that manage them. This article contributes one transparent, practice-based account, written by the programme team, of how the programme was managed and evaluated, including what worked, what proved difficult, and what the team's evaluation data can and cannot show.

Accordingly, this study examines a chemistry education knowledge transfer programme implemented in October 2025 through a university–community partnership in Malaysia and built around four teacher-guide modules, referred to here as Modules A–D. It addresses two research objectives: (RO1) to evaluate teacher-perceived usability in terms of usefulness, ease of use, ease of learning, and satisfaction; and (RO2) to describe how the programme was implemented and managed, the challenges encountered, and the lessons learned. Intended mainly for academics and administrators who plan similar programmes, the article describes how module development, delivery, and evaluation were managed as connected stages and draws lessons for comparable initiatives. It does not assess student learning, and its findings should be read within the limits of a single case.

LITERATURE REVIEW

University–Community Knowledge Transfer and Educational Programme Management

Knowledge transfer in education is often framed as a one-directional movement of expertise from universities to schools. Research on school–university partnerships offers a relational alternative: a systematic review of partnerships aimed at improving teaching and learning practices found that their development is nonlinear, moving from exploration through implementation to sustainability, and that they were evaluated mainly qualitatively during implementation, rarely with validated instruments (Sarmiento-Márquez et al., 2023). Viewed in this way, the community partner is an active party whose resources, priorities, and requests shape what is delivered, and partnership quality depends partly on how clearly responsibilities and contributions are specified and recorded. Programme management therefore involves negotiating scope and documenting contributions, not only planning content and logistics.

Implementation research adds a further dimension. The updated Consolidated Framework for Implementation Research organises the determinants of implementation into domains covering the innovation itself, the outer and inner settings in which it is delivered, the individuals involved, and the implementation process (Damschroder et al., 2022). For short programmes delivered by university teams, staffing, facilitator

preparation, and resource availability are therefore likely to bear directly on what participants experience. Implementation outcomes (acceptability, adoption, appropriateness, feasibility, fidelity, implementation cost, penetration, and sustainability) are distinguished from service and client outcomes, and a recent scoping review mapped how each has been studied over the past decade (Proctor et al., 2023). Applied to educational knowledge transfer, the taxonomy implies that measures of delivery and participant perception describe implementation, not educational effect.

Instructional Innovation in Chemistry Education

Each of the three approaches emphasised by the programme, namely inquiry-based, contextual, and cooperative learning, has an established research base in chemistry education. Jegstad's (2024) systematic review of inquiry-based chemistry education in primary and secondary schools reported generally positive learning outcomes, but found that research emphasised the conceptual and affective domains, with fewer studies addressing the epistemic domain. For context-based chemistry, a systematic review of 25 interventional studies published between 2009 and 2022 found that most reported the approach to be more effective than conventional instruction (Demelash et al., 2023). For cooperative learning, a second-order meta-analysis of 15 first-order meta-analyses reported a moderate overall effect on learning outcomes, with effects differing by technique, academic field, and study design; this synthesis was not specific to chemistry (Güngör et al., 2026). At a broader level, Ahmad et al. (2023) compared 35 pedagogical approaches in high school chemistry and reported an overall positive effect of the interventions examined.

Two observations from this literature are relevant to the present study. First, the evidence for these approaches derives largely from studies of student outcomes, often under research conditions, and its transfer to brief, partnership-based programmes cannot be assumed. Second, the enactment of these approaches depends on teachers, and the move from learning about inquiry to enacting it in schools is not straightforward (Strat et al., 2024). Malaysian studies point in the same direction: creative teaching remains limited in chemistry classrooms (Veerasingham et al., 2021), and teachers' competency and skills shape whether newer approaches, such as green chemistry experiments, reach students (Taha et al., 2021). Together, these observations suggest that teachers may benefit from structured, topic-specific materials that model these approaches, which is the rationale for the teacher-guide modules examined in this study.

Module Development and Perceived Usability

Module-based programmes commonly rely on usability evidence, which addresses whether intended users find a resource useful, easy to use, easy to learn, and satisfying. Lund (2001) developed the Usefulness, Satisfaction, and Ease of Use (USE) questionnaire as a short instrument for measuring these dimensions across domains, using seven-point agreement scales. Recent psychometric work noted the need to refine the full questionnaire and developed a shorter version, the USE-Lite, which showed high reliability and a four-factor structure broadly aligned with the original dimensions (Shanklin et al., 2022). Adaptations such as translation or a change in scale points therefore warrant local reliability evidence, and construct-level scores should be interpreted with awareness that the dimensions may overlap. Moreover, usability is a perception of a resource: in the terms of Proctor et al. (2023), it is closer to acceptability and appropriateness than to evidence of educational effectiveness.

Integrated Programme Evaluation: A CIPP-Informed Perspective

The CIPP model organises evaluation into four complementary components: context evaluation, which assesses needs, problems, and opportunities in order to inform goals; input evaluation, which assesses alternative strategies, plans, and resources; process evaluation, which monitors and documents implementation; and product evaluation, which identifies and assesses outcomes (Stufflebeam, 2003). The model's emphasis on improving rather than proving makes it well suited to programmes whose principal aim is practical development rather than the testing of causal hypotheses. The model has also been applied in Malaysian higher education, for example in a quantitative descriptive evaluation of a Bachelor of Education programme (Sankaran & Saad, 2022).

In this article, CIPP is used as an organising framework for reflecting on the programme; the team did not design its evaluation around CIPP or any other formal framework. The programme rationale recorded in the post-programme reports provides limited evidence for context evaluation. Staffing plans correspond to a limited form of input evaluation (part of RO2), and the post-programme reports to process evaluation (RO2). Teacher-perceived usability and the listed administrative outputs provide a limited form of product evidence (RO1 and part of RO2). Student learning outcomes, which a full product evaluation would ordinarily address, were not measured, so the product component is only partially represented. Combining CIPP with the distinctions drawn by Proctor et al. (2023) keeps three kinds of claims separate throughout the article: claims about implementation (what was delivered, and how), claims about teacher-perceived usability (how teachers judged the modules), and claims about educational effectiveness (whether learning improved), which the present evidence cannot support.

METHODOLOGY

Research Design

This article is a practice-based account, structured as a single-case study, in which the programme team reports its experience of managing a knowledge transfer programme and evaluating its effectiveness. The case is a chemistry education knowledge transfer programme (hereafter, the programme) implemented in October 2025 through a university–community partnership in Malaysia. A single-case framing suits a bounded, time-limited intervention whose design, delivery, and evaluation are examined in their own right rather than generalised statistically (Priya, 2021). The boundary of the case is the programme cycle, extending from module development to the submission of the final programme report; outcomes for students and for the student team members fall outside this boundary because no data on them were collected.

The authors were members of the programme team and were directly involved in planning, delivering, and evaluating the programme. The usability data reported here were collected by the team as part of the programme itself through the teacher usability survey, which served as the programme's effectiveness evaluation and was completed after the modules had been used in the programme. Implementation findings, challenges, and lessons are drawn from the final programme reports prepared by the team after the programme concluded.

The evaluation is quantitative and descriptive. Survey findings are presented as frequencies, percentages, means, and standard deviations, and implementation findings are drawn from the post-programme reports. Because the design includes no comparison group, no pre- and post-intervention measurement, and no measurement of student outcomes, it supports neither causal inference nor claims of statistical significance. Each research objective was mapped to a specific evidence source: RO1 to the usability survey and RO2 to the post-programme reports. As explained in Section 2.4, the CIPP model serves only as an organising framework for reflection.

Programme Context

The programme was organised by an academic department of a Malaysian public university in collaboration with the university's community engagement unit and a district-level education authority, which acted as the community partner. The partner supported the programme through the provision of a venue, accompanying teachers, and technical support. The programme was motivated by the perception that chemistry is a challenging subject, particularly for students with limited exposure to interactive and contextual teaching approaches. It was also positioned as a vehicle for knowledge transfer from the university to schools and for the professional development of the university's pre-service chemistry teachers.

The programme was delivered over three days. The first day was set aside for travel and internal preparatory sessions for the university team. On the second day, which was the main implementation day, four sequential sessions of approximately 75 minutes each were delivered to participating teachers and students, followed by a closing ceremony and an evening post-implementation debriefing session for the university team. The third

day was allocated to an academic visit before the team's return. According to the final report, a host secondary school received the visiting teachers and students and accommodated the university team.

The implementation team comprised a lead academic, four student module coordinators, and four student facilitators; all eight students were pre-service chemistry teachers. The module coordinators also facilitated student activities during the sessions. Each of the four sessions on the main implementation day delivered one of the four teacher-guide modules (Modules A–D). The modules integrated inquiry-based, contextual, and cooperative approaches, each pairing a topic from the upper secondary chemistry syllabus with a particular pedagogical emphasis: Module A addressed matter through an inquiry-based approach, Module B acids and bases through inquiry-oriented practice, Module C manufactured substances in industry through a cooperative approach, and Module D consumer and industrial chemistry through a contextual approach. All modules used low-cost, everyday materials for hands-on activities.

Data Sources and Participants

The study draws on three sources of evidence generated during and after the programme.

Usability survey respondents. Fifteen chemistry teachers from schools in the partner's district completed the usability survey. One respondent (6.7%) was male and 14 (93.3%) were female; one (6.7%) was aged 21–30 years, eight (53.3%) were aged 31–40 years, and six (40.0%) were aged 41–50 years. Six (40.0%) had less than 10 years of science teaching experience, seven (46.7%) had 10–19 years, and two (13.3%) had 20–30 years. All held a bachelor's degree.

Student participants. Ninety upper secondary students took part, the majority from the host school and the remainder from 14 invited schools (Table 2). Students engaged in the hands-on module activities but did not complete any evaluation instrument, and no achievement, attitudinal, or motivational data were collected from them. Student participation is therefore reported as an implementation indicator under RO2.

Post-programme reports and evaluation report. These comprise the final knowledge transfer report submitted to the university's research management function, the programme report submitted to the community engagement unit (including the programme schedule and attendance lists), and the team's evaluation report containing the usability results.

3.4 Research Instrument

Usability questionnaire. Teachers' perceptions of module usability were measured with a questionnaire adapted from Lund's (2001) Usefulness, Satisfaction, and Ease of Use (USE) questionnaire. It comprised respondent demographics, 30 usability items, and an open section for comments. The items covered the four USE constructs: usefulness (8 items), ease of use (11 items), ease of learning (4 items), and satisfaction (7 items). The questionnaire was administered in Malay, and teachers rated each module separately on a five-point agreement scale rather than the seven-point scale used in the original. Teachers completed the questionnaire after experiencing the modules during the programme; the ratings therefore reflect teachers' perceptions following programme exposure rather than sustained classroom use.

3.5 Data Analysis

Analysis was descriptive and organised by research objective. For RO1, the construct-level means and standard deviations for each module were tabulated and compared across constructs and modules.

The summary statistics were taken from the team's evaluation report. Numerical values are reported in place of the descriptive labels ('very high', 'very good') used in that report. No inferential tests were conducted, as the small, non-probability samples and the absence of comparison data would not support them.

For RO2, the post-programme reports were reviewed descriptively (Morgan, 2022). Information was extracted into common categories: participation, schedule and delivery, human resources, administrative outcomes,

implementation challenges, and lessons learned. Challenges and recommendations were summarised as reported by the programme team and then examined for the lessons they offer for managing comparable programmes.

Ethical Considerations and Confidentiality

The usability questionnaire informed teachers that their personal information would be treated as confidential. To protect confidentiality, individual participants are not named, the modules are referred to by neutral labels, and the programme, schools, and locality are described in general terms; the organising university is named only in the author affiliations and the Acknowledgement, and the community partner is not named. Participant information is reported only in aggregate, and no student-level information was used or is reported.

RESULTS

Teacher-Perceived Module Usability

To address RO1, Table 1 presents the usability ratings of 15 teachers on four constructs for each module.

Table 1. Teacher-perceived usability of the four modules by construct (N = 15)

Module	Usefulness	Ease of use	Ease of learning	Satisfaction
Module A	4.55 (0.540)	4.48 (0.618)	4.55 (0.656)	4.57 (0.560)
Module B	4.56 (0.539)	4.51 (0.593)	4.45 (0.654)	4.58 (0.573)
Module C	4.62 (0.537)	4.56 (0.682)	4.50 (0.643)	4.59 (0.470)
Module D	4.58 (0.48)	4.58 (0.51)	4.61 (0.50)	4.61 (0.50)

Note. Values are means with standard deviations in parentheses, on a five-point agreement scale. Standard deviations for Module D are reported to two decimal places, as in the team's evaluation report.

All 16 construct means fell between 4.45 and 4.62, that is, between the 'agree' (4) and 'strongly agree' (5) points of the response scale. This reading treats Likert-type means as interval-level values, which is a simplifying convention. Standard deviations ranged from 0.470 to 0.682. The highest mean was recorded for usefulness in Module C (4.62), and the lowest for ease of learning in Module B (4.45). Within each module, the range of construct means was narrow: 4.48–4.57 for Module A, 4.45–4.58 for Module B, 4.50–4.62 for Module C, and 4.58–4.61 for Module D. Across modules, satisfaction showed the narrowest range (4.57–4.61) and ease of learning the widest (4.45–4.61). The largest difference between modules on any single construct was 0.16 (ease of learning, Modules B and D).

Overall, teachers agreed or strongly agreed that all four modules were useful, easy to use, easy to learn, and satisfying. Given the sample of 15 respondents and the absence of inferential testing, the small differences between modules and constructs are not interpreted as meaningful. The ratings reflect teachers' perceptions after experiencing the modules during the programme, not sustained classroom use or student learning.

Programme Implementation and Management

This section addresses RO2 by describing how the programme was implemented and managed and the challenges encountered.

Programme Implementation and Participation

The programme was implemented over three days in October 2025, as scheduled (Section 3.2). Table 2 summarises the implementation indicators reported in the post-programme reports.

Table 2. Programme implementation indicators

Indicator	Reported
Duration	3 days
Participating teachers	15
Participating students	90
Participating secondary schools	15 (host school plus 14 other schools)
Students by school	62 from the host school; 28 from 14 other schools (2 per school)
Lead academic	1
Student team members (pre-service teachers)	8 (4 module coordinators and 4 facilitators)
Module sessions	4

Note. Values are taken from the final report and the programme report.

The programme reached 15 teachers and 90 students from 15 schools, three times its target of 30 students. Much of this additional reach came from the host school, which asked to include students who had not been registered as participants. Delivery was supported by the lead academic, four student module coordinators, and four student facilitators, and all four module sessions were delivered as planned.

Programme Completion and Administrative Outcomes

All eight administrative milestones were completed: module preparation and facilitator training; implementation of each of the three programme days; report preparation; report submission to the university's community engagement unit; completion confirmation from that unit; and report submission to the university's research management function. The programme also produced several administrative and dissemination outputs, including partnership documentation, a technical report, a completion memorandum, an intellectual property registration, and public dissemination materials.

The final report also records the team's observations that the quality of chemistry teaching and learning improved, that students became more motivated, that teachers adopted contextual activities, and that the student team members developed facilitation, communication, leadership, and reflective skills. These observations were not measured and are therefore presented as the team's reflections rather than as findings.

Implementation Challenges

The final report identifies three operational challenges: a shortage of facilitators; a shortage of materials and equipment; and an unplanned request from the host school to include students not registered as participants. The shortages arose largely from the third challenge: the eight student team members and the prepared materials, intended for a smaller group, had to serve 90 students. The final report draws two lessons for future programmes: prepare additional materials and equipment as a contingency, and recruit facilitators from a wider pool of students.

DISCUSSION

Teacher-Perceived Usability

With respect to RO1, teacher ratings were consistently favourable, indicating that the modules were well received by teachers. Their evidential weight is nonetheless limited: the ratings come from 15 teachers who responded after experiencing the modules during the programme.

The clustering of all 16 means within a 0.17-point band near the top of the scale suggests limited discrimination across modules and constructs. This may reflect genuinely positive perceptions, a ceiling effect, social desirability in an evaluation conducted within a partnership, or a combination of these. Because

all items were positively worded and each teacher rated the four modules within a single questionnaire, acquiescence and carry-over (halo) effects also cannot be excluded. The USE questionnaire captures subjective perceptions of usefulness, ease of use, ease of learning, and satisfaction (Lund, 2001), not task performance or learning. In the taxonomy of Proctor et al. (2023), such ratings are closest to perceptual implementation outcomes such as acceptability and appropriateness. Favourable teacher perceptions are therefore a promising precondition for adoption, rather than evidence of improved student learning.

This pattern is consistent with comparable Malaysian chemistry module studies. Hamid et al. (2021) reported high student perceptions of the content, usability, design, and effectiveness of an e-content module for a chemistry massive open online course. Apriwanda et al. (2021) reported a response rated as very good (92.36%) from 27 purposively sampled chemistry teachers for a dual-mode chemistry module. The comparison is indicative rather than direct, because the instruments differed: Hamid et al. (2021) surveyed students rather than teachers, and Apriwanda et al. (2021) reported an overall teacher response percentage rather than construct-level ratings such as those obtained with the USE questionnaire. As in the present study, however, both evaluations relied on self-reported perceptions rather than classroom testing. Uniformly high ratings therefore appear to be common at this stage of module development, which strengthens the case for following perception surveys with evidence of classroom use and student learning.

Programme Implementation and Collaboration

With respect to RO2, the programme was delivered as scheduled and all administrative milestones were completed, even though conditions were more demanding than anticipated. Student participation tripled, leaving roughly 11 students per student team member. Given that the resources and capacity of the delivery setting shape implementation (Damschroder et al., 2022), increased reach under constrained capacity may have reduced the intensity of hands-on facilitation. For the team, the lesson was clear: greater reach is welcome, but it has to be matched by enough facilitators and materials.

A comparable Malaysian university–school partnership points to the same pressure. Over five years, the Universiti Malaysia Sabah STEM mentor-mentee outreach programme involved 732 rural secondary students, with 342 in-service and 99 pre-service teachers serving as mentors, and its evaluation concluded that adequate guidance from mentors was critical in helping students complete hands-on design tasks (Siew, 2021). Because that programme, like the present one, relied on teacher mentors and pre-service facilitators, the two cases together suggest that facilitator-to-student ratios merit explicit planning in partnerships of this kind.

From a partnership perspective, the partner's support and the host school's request to enlarge participation reflect active partner involvement, but they also show the value of agreeing scope and resource commitments in advance. This reading reflects the team's perspective; the partner's view was not formally captured.

Integrated Interpretation and Contribution

Organised by the four CIPP components (Stufflebeam, 2003), the team's experience shows that the evaluation was stronger at some stages than at others: context evidence was limited to the documented programme rationale, input evidence was limited to staffing plans, process evidence was largely administrative, and product evidence was confined to teacher perceptions and programme outputs. The evidence therefore supports statements about what was delivered and how it was received, but not about what changed for students or schools. The article's contribution is accordingly practical: it shares how one programme team bridged a university and its partner schools through a short knowledge transfer programme, how the programme was managed and evaluated, and what the team would do differently. This combination distinguishes the present account from the comparable Malaysian studies discussed above, which reported either user perceptions of modules (Apriwanda et al., 2021; Hamid et al., 2021) or the outcomes of a university–school outreach partnership (Siew, 2021), but not module development, user evaluation, and programme management within a single evaluated cycle. As these observations derive from a single case, they are offered as propositions for examination in other contexts rather than as generalisations.

Table 3 summarises, for each CIPP component, the evidence collected, the key findings, and the lessons for evaluating future programmes.

Table 3. CIPP-informed summary of evaluation evidence, findings, and lessons

CIPP component	Evidence collected (RO)	Key findings	Lessons for future evaluation
Context	Programme rationale recorded in the post-programme reports	Programme motivated by the perceived difficulty of chemistry and students' limited exposure to interactive and contextual approaches	Document the basis for selecting module topics and approaches
Input	Staffing plan (RO2)	One academic and eight student team members (four module coordinators and four facilitators), planned for a smaller group of students	Set target facilitator-to-student ratios and contingency resources
Process	Schedule; administrative milestones; participation; challenges (RO2)	Delivered as scheduled; all milestones completed; 15 teachers and 90 students; facilitators and materials stretched	Agree participant limits with partners; record session-level attendance and fidelity
Product (partial)	Teacher-perceived usability of 15 teachers; programme outputs (RO1, RO2)	Mean ratings 4.45–4.62 across all constructs and modules	Retain respondent-level data; follow up classroom adoption and student learning

Note. RO = research objective. The mapping was prepared by the authors after the programme; the original evaluation was not designed around the CIPP model.

Lessons Learned for Programme Management

Addressing the final part of RO2, the team's experience points to four lessons for those managing comparable programmes. First, the basis for selecting module topics and pedagogical approaches should be documented at the design stage. Second, respondent-level evaluation data should be retained to permit reliability analysis. Third, partnership agreements should specify participant limits, procedures for accommodating additional participants, and target facilitator-to-student ratios, together with contingency resources. Finally, programmes that intend to claim effects on teaching or learning must plan follow-up measures of classroom use and student outcomes at the design stage, consistent with the improvement-oriented purpose of evaluation emphasised in the CIPP model (Stufflebeam, 2003).

5.5 Study Limitations and Future Research

This study examines a single, short programme and relies on small non-probability samples. Only summary statistics were available, and reliability evidence for the survey instruments was not obtained. No student outcome data were collected, and the usability findings reflect short-term teacher perceptions. The post-programme reports were prepared for institutional reporting and do not capture partner or participant perspectives. All authors were members of the programme team (the project leader and four student module coordinators); this is therefore an insider account, and the authors' involvement may have influenced the interpretation of the findings. Future research should examine whether teachers adopt the modules in their classrooms over time, assess student outcomes using designs appropriate for causal inference, incorporate partner perspectives on the collaboration, and compare implementation across multiple sites.

CONCLUSION

This article has shared a programme team's experience of developing, delivering, and evaluating a short university–community chemistry education programme in Malaysia. Teachers rated the modules favourably

for usefulness, ease of use, ease of learning, and satisfaction (RO1). The programme completed its scheduled activities and administrative milestones and reached three times as many students as targeted, an achievement that also stretched facilitators and materials (RO2).

In terms of effectiveness, the programme succeeded in delivering modules that teachers judged useful and usable; whether it improved teaching or student learning remains to be established. Bridging universities and schools in this way is feasible even for a short, modestly resourced programme, provided that partners agree on scope and evaluation is planned from the outset. The article's contribution is primarily practical: it shows how module development, delivery, and evaluation can be managed as connected stages of one programme, and it draws the lessons set out in Section 5.4 for teams planning similar initiatives, within the limitations noted in Section 5.5.

DECLARATIONS

Ethical approval and consent

The data reported in this article were collected by the programme team as part of the programme's own effectiveness evaluation. All procedures involving human participants were performed in accordance with the ethical standards of the institutional research committee and with the 1964 Declaration of Helsinki and its later amendments. Written informed consent was obtained from all individual participants included in the study. The study involved no intervention beyond the original programme activities.

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Competing interests

All authors were members of the team that designed, delivered, and reported the programme evaluated in this study: the first author was the project leader, and the remaining authors were students who served as module coordinators.

Data availability

The data analysed in this study consist of programme records and summary evaluation statistics, collected by the programme team, that contain confidential institutional and personal information; they are therefore not publicly available. All aggregate data used in the analysis are reported in the article.

Author contributions

Muhd Ibrahim Muhamad Damanhuri led the project and wrote the manuscript. Alfirah Ahmad coordinated Module D. Raashini Manimaran coordinated Module B. Saib Haikal Saufi coordinated Module C. Mahkrus Agam Mohd Subhan coordinated Module A.

Use of AI-assisted tools

During the preparation of this manuscript, the authors used ChatGPT and Elicit to assist with drafting and revising text, improving language and clarity, and identifying related literature. These tools were not used to generate, analyse, or interpret the study data. After using them, the authors reviewed and edited the content as needed, verified all cited sources against the original publications, and take full responsibility for the content of the publication.

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