

Bridging Borders through STEM: An International University-Community Service Model for Marginalised Indonesian Children in Malaysia

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ABSTRACT

Children of Indonesian migrant families in Malaysia frequently sit outside the formal education system, and many grow up with little exposure to Science, Technology, Engineering and Mathematics (STEM). This gap in early STEM exposure narrows their later options and reinforces the disadvantage their families already face. This paper reports on an international community-service collaboration between Universiti Teknologi MARA (UiTM), Malaysia and Universitas Wiraraja (UNIJA), Indonesia, delivered under the SULAM and *Sanggar Belajar* schemes with the support of the Embassy of Indonesia in Malaysia. This paper situates the intervention within the wider literature on migrant-child education, STEM equity pedagogy, service-learning and participatory action research which leads to detailed explanation of programme design, outcomes and implications. Forty marginalised children across two communities in Selangor (Teluk Panglima Garang and Jalan Kebun) took part in a phased programme combining content co-creation, a training-of-trainers webinar, and hands-on reading-counting-writing (3M/CaLisTung) activities delivered by 49 undergraduate students and six academic staff from both universities. Caretaker feedback, embassy observation and student reflection converge on three outcomes: improved engagement with foundational numeracy and literacy tasks, stronger cross-cultural understanding through paired Malaysian and Indonesian cultural activities, and measurable growth in participating students' civic and professional competencies. The paper closes with implications for how higher-education institutions might scale such short-cycle, cross-border service-learning models, and identifies the methodological limitations that being the notably absence of a control group and of longitudinal follow-up that should guide future study designs. The programme's alignment with Sustainable Development Goals 1, 4 and 10 is discussed as a basis for replication by other institutions working with under-served migrant populations.

Keywords: STEM education, marginalised children, migrant education, service-learning, international collaboration, Malaysia, Indonesia

INTRODUCTION

Malaysia hosts a substantial population of Indonesian migrant workers where the children of these families whether documented or undocumented often fall outside the reach of the national schooling system (Devadason & Meng, 2014). As children of migrant workers do gain access to some form of schooling, it is typically informal, under-resourced, and delivered by community or faith-based volunteers rather than trained teachers (Crisis & Parasuraman, 2016). This structural exclusion compounds over time for a child who misses several years of foundational literacy and numeracy instruction enters adolescence with fewer options for further study or formal employment, and the disadvantage is passed, in effect, to the next generation.

Universiti Teknologi MARA (UiTM), Malaysia and Universitas Wiraraja (UNIJA), Indonesia, together with the Embassy of Indonesia in Malaysia, designed a short-cycle community-service programme to respond to this gap

but not attempting to substitute for formal schooling, but by giving marginalised Indonesian children in Shah Alam, Selangor, a structured, positive first exposure to STEM-related reading, counting and writing activities. The Malaysian side of the collaboration operated under UiTM's SULAM (Service-Learning Malaysia - University for Society) scheme, and the Indonesian side under UNIJA's Sanggar Belajar (community learning studio) initiative. Both frameworks share a common instructional anchor that are Malaysia's 3M concept (Membaca, Mengira, Menulis - reading, counting, writing) and Indonesia's closely related CaLisTung concept (Membaca, Menulis, Berhitung – reading, counting, writing), which together gave the two student a shared pedagogical vocabulary despite the planning of the programme came from two different countries (Tarigan & Putri, 2022).

This manuscript situates the programme within four bodies of literature including migrant-child education in Malaysia, STEM equity pedagogy, service-learning in higher education, and participatory action research with a fuller account of programme design, a structured presentation of findings, and discussion of the practical and policy implications for institutions considering similar cross-border collaborations.

Four objectives guided the programme: (1) to build marginalised children's soft skills and civic awareness through STEM-oriented informal learning; (2) to give undergraduate students from both universities a setting in which to apply classroom theory to real community practice; (3) to establish a recurring international community-service pathway between the two universities; and (4) to strengthen academic and research cooperation between UiTM and UNIJA under the diplomatic support of the Indonesian Embassy.

Educational Marginalisation of Migrant Children in Malaysia

Malaysia's education system does not universally guarantee school placement for the children of foreign workers, and enrolment for this group depends on a combination of legal status, documentation, and the availability of alternative learning centres run by non-governmental organisations or embassies (Crinis & Parasuraman, 2016; Devadason & Meng, 2014). United Nations High Commissioner for Refugees (UNHCR) and United Nations Children's Fund (UNICEF) situational reports on refugee and migrant children in Malaysia consistently describe a pattern in which informal 'learning centres' fill the gap left by formal schooling, but these centres vary widely in resourcing, curriculum quality and continuity (UNICEF Malaysia, 2018). The consequence, as several regional studies of marginalised education in Indonesia and Malaysia have shown, is a widening achievement gap that tracks socio-economic status rather than ability (Mukminin & Habibi, 2021; Suardika et al., 2020; Taena et al., 2023). Community-based, short-cycle interventions do not resolve the structural exclusion, but the literature on non-formal education suggests they can meaningfully raise a child's baseline literacy and numeracy confidence and, over repeated cycles, act as a bridge toward formal enrolment where legal pathways exist (Yuliani & Yulianto, 2023).

STEM Education as a Tool for Equity and Empowerment

Science, Technology, Engineering & Mathematics (STEM) education is widely framed in the literature not merely as a content area but as a way of thinking which integrates disciplinary knowledge with problem-solving, evidence-based reasoning and creativity (Bybee, 2010). The U.S. National Research Council's synthesis of K-12 STEM interventions found that early, hands-on and inquiry-based exposure to STEM concepts was one of the more reliable predictors of sustained interest and later achievement, particularly for children who might otherwise never encounter STEM outside a formal classroom (National Research Council, 2011). For marginalised populations specifically, STEM-based informal programmes have been shown to build not only academic skill but also a sense of agency and future orientation that formal deficit-focused remedial instruction often fails to instil (Zakeri et al., 2022). This is consistent with findings from Suryani et al. (2023) that a STEM-oriented pedagogical approach improved Indonesian primary pupils' everyday problem-solving ability more than a conventional lecture-based approach covering the same content.

Service-Learning and International Community Engagement in Higher Education

Service-learning is defined by Jacoby (2015) as a credit-bearing educational experience in which students participate in an organised service activity that meets identified community needs, and then reflect on that activity to gain further understanding of course content and a broadened sense of civic responsibility. Besides, Eyler and Giles (1999), in one of the most cited empirical treatments of the field, found that structured reflection is what converts a community placement into durable learning, a finding that shaped how the UiTM-UNIJIA programme built in a formal post-programme discussion and poster-reporting stage for participating students. International or cross-border service-learning adds a further layer of students must reconcile differing institutional systems, languages and cultural expectations while still delivering a coherent programme to the community they serve. Where earlier single-institution service-learning models tend to concentrate learning gains in the visiting students, dual-institution models such as the joint UiTM-UNIJIA design has distributed both the planning workload and the learning benefit across two student cohorts, which the programme's post-activity reflections suggest strengthened cross-cultural competency on both sides.

Participatory Action Research (PAR) in Community-Based Educational Interventions

Participatory action research (PAR) treats the people affected by a problem - in this case, community leaders and caretakers of the marginalised children - as co-designers of the intervention rather than passive recipients of it (Kemmis, McTaggart, & Nixon, 2014). Saunders, Lewis and Thornhill's (2019) widely used research methods framework similarly emphasises that community-facing interventions gain relevance and legitimacy when local stakeholders are consulted at the planning stage and given a channel for iterative feedback during implementation. The UiTM-UNIJIA programme applied this principle through its content co-creation phase, in which community leaders' input shaped the choice of activities before the training-of-trainers session, and through the caretaker questionnaire administered after the programme, which functioned as a feedback loop for future iterations of the collaboration.

Cross-Border University Collaboration and Cultural Exchange

Beyond the immediate educational aim, cross-border university partnerships are increasingly framed in the higher-education internationalisation literature as a mechanism for building longer-term institutional and diplomatic ties (Yuliani & Yulianto, 2023). Embedding cultural-exchange elements which in this programme includes Indonesian traditional dance performed by UNIJIA students and Malaysian traditional games introduced by UiTM students, it is consistent with findings that pairing academic content with cultural performance strengthens participants' sense of shared regional identity and mutual respect, particularly for children whose own cultural belonging is complicated by their families' migration status (Tarigan & Putri, 2022).

Conceptual Framework

This study anchors its design in a two-strand conceptual framework that combines Bringle and Hatcher's (1995) service-learning model with Kemmis, McTaggart and Nixon's (2014) participatory action research (PAR) cycle of plan-act-observe-reflect. The service-learning strand supplies the underlying premise that structured community placement, paired with deliberate reflection, produces learning gains for both the community served and the students delivering the service (Eyler & Giles, 1999), while the PAR strand supplies the operating cycle through which that placement was actually designed, delivered and adjusted. Table 1 maps the programme's four implementation phases onto this combined framework, making explicit the theoretical rationale behind each phase rather than presenting the phases as an unexplained sequence of activities.

Framing the programme this way clarifies two things that a purely descriptive researches leaves implicit. First, the model is iterative rather than linear: the 'reflect' stage (student discussion, poster report, and caretaker questionnaire) is intended to feed forward into the 'plan' stage of a subsequent cycle, which is why this paper treat caretaker and embassy feedback as programme-design data rather than only as an evaluation outcome. Second, the model is explicitly dual-institution: both the 'plan' and 'act' stages were co-owned by UiTM and UNIJIA rather than led by one university and merely 'hosted' by the other, which is the conceptual basis for the role's distinction presented in Section *Roles and Responsibilities of Partner Institutions and Community* later.

Table 1. Mapping of PAR Cycle Stage and SULAM Components

PAR Cycle Stage	Service-Learning Component	Corresponding Programme Phase
Plan	Needs identification and community consultation	Phase 1: Content development, informed by community leaders' input on the children's needs
Plan / Act (preparation)	Structured preparation of student facilitators	Phase 2: Collective content review; Phase 3: Training of trainers
Act / Observe	Organised service activity meeting an identified community need	Phase 4: Community engagement (on-site delivery)
Reflect	Structured reflection converting service into learning (Eyler & Giles, 1999)	Post-programme student discussion, poster reporting, and caretaker feedback questionnaire

METHODOLOGY

This study used a mixed-methods, practice-based design combining participatory action research principles with a structured caretaker survey, consistent with Saunders et al.'s (2019) guidance that community-facing research should build in iterative stakeholder feedback rather than a single end-point evaluation.

Participants

The programme involved 40 marginalised Indonesian children drawn from two communities in Selangor which are Teluk Panglima Garang and Jalan Kebun (20 children per site, 80 children in total across both sites over the two-day engagement), one attaché from the Embassy of Indonesia in Malaysia, 49 undergraduate students (35 from UiTM, 18 from UNIJA), and six academic staff supervisors (four from UiTM, two from UNIJA).

Roles and Responsibilities of Partner Institutions and Community

A recurring gap in prior descriptions of this programme was a clear division of labour between the four categories of stakeholder involved. Table 2 sets out each stakeholder's primary role and the phase(s) in which they were most actively involved, consistent with the co-ownership principle set out in the conceptual framework above.

Table 2. Roles of Stakeholders

Stakeholder	Primary Role	Phase(s) Involved
UiTM (Malaysia)	Malaysian-side coordination; student recruitment and supervision; co-development of materials; on-site delivery	Phases 1-4
UNIJA (Indonesia)	Indonesian-side coordination; student recruitment; cultural-exchange coordination; co-development of materials; on-site delivery	Phases 1-4
Embassy of Indonesia in Malaysia	Diplomatic support; attaché observation; liaison between universities and community leaders; logistical facilitation	Phases 2 and 4
Community leaders (Teluk Panglima Garang & Jalan Kebun)	Site access; content co-design input; caretaker mobilisation; ongoing feedback channel	Phases 1, 2 and 4
Caretakers	Informed consent; post-programme feedback via questionnaire	Phase 4 and post-programme
Student facilitators (UiTM & UNIJA)	Material development; on-site delivery; structured reflection and reporting	Phases 1-4

Programme Phases

The programme was delivered in four sequential phases:

1. Phase 1 - Content development (three weeks): Joint UiTM-UNIJA student teams developed STEM-aligned reading, counting and writing materials appropriate for the target age group.
2. Phase 2 - Collective content review (one week): Students and lecturers from both universities reviewed and co-refined the materials with community leaders' input, working within known space and logistics constraints at the delivery sites.
3. Phase 3 - Training of trainers (one day, webinar format): Participating students were briefed on facilitation techniques and child-engagement protocols appropriate to the two communities.
4. Phase 4 - Community engagement (two days): On-site delivery of the 3M/CaLisTung activities in Teluk Panglima Garang and Jalan Kebun, alongside the paired cultural-exchange performances.

Language and Cultural Responsiveness

Instructional materials and on-site facilitation were delivered primarily in Bahasa Malaysia and Bahasa Indonesia, with facilitators code-switching between the two closely related languages as needed to match individual children's comprehension. This is a practical necessity given that the children's own language exposure varied depending on how long their families had been resident in Malaysia. Materials avoided reliance on formal script-heavy instructions, favouring visual and hands-on formats for the counting and writing activities so that a child's engagement was not gated by reading fluency in either language.

The training-of-trainers session (Phase 3) briefed all facilitators specifically on this dual-language approach and on broader cultural-responsiveness considerations. For example, being attentive to children's possible unfamiliarity with classroom conventions such as raising a hand or sitting in rows so that facilitators adapted their delivery style rather than expecting the children to adapt to an unfamiliar format. The paired cultural-exchange performances (Indonesian traditional dance and Malaysian traditional games) were themselves a deliberate cultural-responsiveness mechanism, designed to affirm rather than subordinate either national identity represented among the children and student facilitators.

Instruments and Data Collection

A structured questionnaire was administered to caretakers at both sites following the engagement days to capture their perceptions of the children's engagement and the programme's conduct. In addition, participating students from both universities took part in a facilitated post-programme discussion, the output of which was consolidated into a one-page summary poster documenting activities, outcomes and lessons learned that served as the programme's internal report and, subsequently, as one of the qualitative data sources for this paper. Observational notes from the attaché of the Indonesian Embassy were also incorporated as a secondary qualitative source.

Ethical Considerations

Given the participants' age and the sensitivity of their families' migration status, no personally identifying information was collected from the children; caretaker consent was obtained prior to participation, and community leaders acted as gatekeepers for site access throughout the planning phase, consistent with PAR practice (Kemmis et al., 2014).

RESULTS AND DISCUSSION

Children's Engagement with Foundational Skills

Facilitators observed the strongest enthusiasm in the counting-based activities, which appeared to translate directly into children's willingness to attempt and complete numeracy tasks. The phonetics-based reading activities produced steady, if less pronounced, gains in decoding and comprehension over the two days. Writing-focused tasks, designed around fine-motor and hand-eye coordination exercises, were well received and, according to facilitators' observation, supported both handwriting mechanics and broader cognitive engagement. These patterns are broadly consistent with the STEM-equity literature's expectation that hands-on, low-stakes activity formats lower the barrier to participation for children with little or no prior formal schooling (Bybee, 2010; Zakeri et al., 2022).

Caretaker and Embassy Perceptions

Caretaker questionnaire responses were uniformly positive, and several respondents described the programme as an 'eye-opener' regarding their children's capacity to engage meaningfully with structured learning activities - a description that, read against the marginalisation literature, points to how rarely these children are given the opportunity to demonstrate this capacity in the first place (Mukminin & Habibi, 2021; Suardika et al., 2020). The Embassy attaché's feedback echoed this, with an expressed interest in future iterations of the programme, which indicates interest for continuing the UiTM-UNIJIA-Embassy partnership beyond a single cycle.

Cultural Exchange Outcomes

The paired cultural performances of Indonesian traditional dance presented by UNIJIA students and Malaysian traditional games introduced by UiTM students appeared to do more than provide entertainment between learning sessions. Facilitators reported that children responded to the performances with visible pride in their own cultural heritage, consistent with the internationalisation literature's finding that pairing content delivery with cultural exchange strengthens participants' sense of belonging (Tarigan & Putri, 2022).

Student Learning Outcomes

For the 49 participating undergraduates, the post-programme reflective discussion surfaced recurring themes of applied leadership, cross-cultural communication and a deepened understanding of the structural barriers facing migrant communities. This is consistent with Eyler and Giles' (1999) argument that it is the structured reflection stage and not the service activity alone that converts a placement into durable learning, and supports the case for retaining a formal reflection and reporting phase in future cycles of the programme.

Implications for Practice and Policy

Three implications follow from this programme. First, short-cycle, phase-based service-learning models of this kind appear to be a low-cost, replicable way for universities to extend STEM exposure to children who fall outside the formal schooling system, without requiring the institutional commitment of running a standing school. Second, dual-institution delivery with splitting planning and facilitation across two universities in two countries appears to distribute learning benefits more evenly across both student cohorts than a single-institution model would, and gives the programme a built-in mechanism (the shared 3M/CaLisTung pedagogical frame) for reconciling differing national curricula.

Third, embedding a caretaker feedback loop and community leader co-design stage, in line with PAR principles, is likely to matter more for programme legitimacy and continuity than any single activity choice within the curriculum itself (Kemmis et al., 2014; Saunders et al., 2019). Institutions seeking to replicate this model should budget explicitly for the content co-creation and training-of-trainers phases, which the present programme found to be as important to outcomes as the on-site delivery days themselves.

Limitations and Directions for Future Research

This study is descriptive and practice-based rather than experimental as there was no control group, no pre/post standardised measure of literacy or numeracy gain, and no longitudinal follow-up to establish whether the engagement produced effects that persisted beyond the immediate programme. The caretaker questionnaire, while positive, was not validated as a psychometric instrument and is best read as an indicator of satisfaction rather than of measured learning gain.

Future iterations of this collaboration would benefit from a pre/post skills assessment, a larger and more geographically varied sample, and a follow-up survey administered several months after the engagement to assess retention. A comparative study across multiple community sites, or against a matched group of children in formal alternative learning centres, would also help establish how much of the observed engagement is attributable to the STEM activity design itself versus the novelty of a one-off event.

CONCLUSIONS

This paper has accounted the UiTM-UNIIA-Embassy of Indonesia collaboration by situating the programme within the literature on migrant-child marginalisation, STEM equity pedagogy, service-learning and participatory action research, and by presenting a fuller account of programme design, findings and implications. The evidence, though descriptive rather than experimental, suggests that a short-cycle, dual-institution, PAR-informed service-learning model can meaningfully raise marginalised children's engagement with foundational STEM-related skills while simultaneously building participating university students' civic and cross-cultural competencies. The programme's explicit alignment with SDG 1 (No Poverty), SDG 4 (Quality Education) and SDG 10 (Reduced Inequalities) situates it within a broader institutional mandate that other universities working with under-served migrant populations may find a useful template to adapt, provided they budget for the co-design and reflection phases that this study identifies as central to the model's legitimacy and impact.

Conflict Of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

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