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Enhancing the Capacity of CLC Teachers in Tawau, Sabah, Malaysia to Innovate Game-Based Digital Assessment

Nisa A'rafiyah Tri Wulandari[1*], Monika Handayani[2], Maya Puspitasari[3], Rika Aprianti[4], Nova Tri Prasetyo[5], Aiza Sunarto[2], Mad Noor Madjapuni[6]

[1]Pancasila and Civic Education Bachelor Program, Universitas Terbuka, Banten, Indonesia
[2]Elementary School Teacher Education Bachelor Program, Universitas Terbuka, Banten, Indonesia
[3]English Language Education Master Program, Universitas Terbuka, Banten, Indonesia
[4]Physics Education Bachelor Program, Universitas Terbuka, Banten, Indonesia
[5]Islamic Religious Education Bachelor Program, Universitas Terbuka, Banten, Indonesia
[6]Faculty of Education and Sports Studies, Universiti of Malaysia Sabah, Malaysia
*Corresponding Author: nisa.wulandari@ecampus.ut.ac.id

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ABSTRACT

Background: This community service program aimed to address gaps in digital assessment literacy among Community Learning Center (CLC) teachers in Tawau, Sabah, Malaysia, and to support more engaging assessment practices in low-resource educational settings.
Contribution: The program enhanced teachers' practical capacity to design and implement game-based digital assessments and provided limited infrastructure support to improve the feasibility of sustained use in CLC classrooms.
Method: The program was designed using the Community Tool Box framework, emphasizing community needs assessment and an evaluation plan. It was delivered through two modes: an online training session and an in-person workshop.
Results: The online training involved 117 educators from multiple CLCs across Sabah, followed by an in-person workshop with approximately 100 teachers in Tawau. Participants produced or designed game-based digital assessment activities using Blooket as a hands-on output, and post-program support included educational grants (projectors, laptops, and a Blooket Plus account) to strengthen implementation sustainability.
Conclusion: The two-mode training model produced concrete assessment outputs and strengthened readiness to integrate game-based digital assessment in CLC contexts. Future work should extend evaluation toward classroom-level impact and test replication across CLC districts with varying resource constraints.

1. Introduction

Education for the children of Indonesian migrant workers in Sabah operates within a complex cross-border educational ecosystem shaped by migration governance, institutional gaps, and community-based support mechanisms. Previous studies show that Indonesia–Malaysia collaborative policy frameworks remain important for expanding educational access for migrant worker families in Sabah [1], while transnational identity dynamics also shape migrant children's learning experiences and the forms of educational provision available to them [2]. Beyond formal diplomacy, educational access is often sustained by non-state and community-based actors that compensate for the limitations of formal systems [3]. Recent international studies further show that educational access for non-citizen and migrant children in Malaysia is mediated by multi-level barriers, including legal status, funding limitations, institutional exclusion, and uneven support structures [4]. In this broader landscape, migrant communities and intermediary actors also mobilize advocacy and cross-sector collaboration to secure education rights [5], while alternative learning centers in Sabah function not only as educational spaces but also as practical responses to governance gaps affecting migrant populations [6].

This context is important because the challenge faced by CLCs is no longer limited to educational access alone, but also concerns the quality and relevance of classroom practice in low-resource environments. One major challenge is the shift of teaching and assessment into the digital domain. In such contexts, assessment is not merely a tool for measuring learning outcomes, but also a mechanism for improving instruction and supporting student engagement [7]. Conceptually, high-quality assessment contributes to better teaching and learning, and teacher self-assessment can function as a reflective mechanism to improve instructional practice. However, the available literature indicates that teachers' knowledge and skills are closely associated with their attitudes toward online assessment, while readiness for digital transformation across Sabah remains uneven. Schools in underprivileged contexts also require stronger digital leadership and better strategic support to implement technology meaningfully [8]. More broadly, digital education in low-resource settings is often constrained by unstable infrastructure, limited device access, and weak institutional support [9]-[10].

The challenge is even more specific when viewed through the lens of teacher assessment literacy and digital assessment literacy. Digital strategies cannot function effectively when teachers have limited foundational digital capacity or when institutional conditions do not support implementation [11]. A recent scoping review identifies teacher assessment literacy in digital environments as involving the capacity to design, administer, interpret, and use assessment meaningfully in technology-enhanced settings [12]. and teacher professional development is crucial for addressing systemic barriers to assessment literacy [13]. Gaps in digital assessment literacy also appear in studies on assessment competence and practices (including digital assessment literacy) [14], as well as findings from specific communities (e.g., Indigenous communities) showing low teacher assessment literacy with implications for the quality of assessment practices [15]. Other literature further confirms that assessment literacy

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includes the ability to design assessment tasks [16], varies across contexts and countries [17], and is not always adequately translated into teacher practice [18], including in digital language assessment contexts [19]. At the implementation level, barriers to online and technology-based assessment include policy constraints, limited resources, technical disruptions, integrity concerns, and unequal learning experiences [20], [21]. In multicultural and low-resource settings, assessment must also remain culturally responsive so that technology does not reproduce or intensify existing inequalities [22].

The urgency of this issue is reinforced by the baseline needs assessment conducted prior to the intervention. The survey of 53 CLC teachers showed that most respondents taught in rural or semi-rural locations, and more than half reported never having received formal training related to educational technology or digital assessment. The data also indicated uneven student access to devices and internet connectivity, while teachers reported relatively high motivation to learn new digital tools but lower perceptions of institutional support, budget allocation, and training sufficiency. These findings suggest that the main problem in the CLC ecosystem is not simply teachers' willingness to innovate, but the combination of limited digital assessment capacity, uneven infrastructure, and weak systemic support for sustainable implementation.

Building on this problem, the state of the art suggests that improving assessment quality in resource-constrained contexts generally follows two pathways: (a) innovating assessment approaches and formats, and (b) strengthening teacher capacity through training/mentoring and the use of technology. A review of "innovative assessment" synthesizes practices and case studies showing that innovative assessment design can improve learning quality when supported by adequate implementation prerequisites [23]. In rural/low-resource contexts, studies on digital assessment tools such as Socrative indicate potential gains in engagement and feedback quality, but these still depend on connectivity and device availability [24]. Similar findings are reported for Word wall, which highlights the need for teachers' creative strategies to sustain engagement amid limited access and devices [25].

From a capacity-building perspective, training programs for developing digital assessments (e.g., Quiz-Maker iSpring), training–mentoring schemes to produce digital assessment instruments [26], and training on digital assessment strategies in school-based community service settings (Thailand) [27] show that structured interventions can strengthen teachers' ability to design assessments. Digital alternative assessment practices among primary school teachers also indicate a shift toward more varied assessment formats [28]. Across broader technology training, structured training and technical support are essential for teachers to adopt technology meaningfully [29]. In line with this community service focus, Blooket-based gamification has been reported to improve learning motivation and/or learning outcomes across different contexts [30]–[32]. Therefore, a relevant solution for low-resource CLC ecosystems is to strengthen teachers' capacity to design and implement engaging (game-based) digital assessments using Blooket, while ensuring the approach remains adaptive to infrastructure constraints and varying levels of digital readiness.

Despite this growing literature, an important gap remains. Studies on migrant education in Malaysia mainly focus on access, governance, and rights-based issues [1]–[6], while studies on assessment literacy and digital assessment largely focus on teacher competence in general educational settings [12], [13], [22], [14]–[21]. Likewise, studies on digital assessment tools and gamification commonly address classroom engagement or platform effectiveness [24]–[32], but rarely examine how a structured training intervention can strengthen teachers' digital assessment capacity in community-based migrant education settings such as CLCs in Sabah. As a result, the literature still provides limited guidance on how teacher capacity building, game-based digital assessment, and low-resource migrant education contexts can be integrated into a context-sensitive intervention model.

Theoretically, this study is grounded in the concepts of teacher assessment literacy, digital assessment literacy, and teacher professional development in low-resource settings. These perspectives are used to understand how teachers build the capacity to design, adapt, and implement assessment through digital platforms under conditions of infrastructural limitation and varied student access. Within this framework, gamified digital assessment is treated not merely as a technological tool, but as a pedagogical strategy whose effectiveness depends on teacher competence, contextual adaptation, and implementation support.

This study aims to examine how a structured training intervention can strengthen the digital assessment capacity of CLC teachers in Tawau, Sabah, Malaysia, through the use of game-based digital assessment using Blooket. Specifically, this study addresses the following research questions: (1) how does a structured training intervention support CLC teachers in designing game-based digital assessments; (2) how do CLC teachers perceive the usefulness and feasibility of Blooket-based assessment for classroom practice in migrant education settings; (3) what contextual constraints and support needs shape the implementation of game-based digital assessment in low-resource CLC environments.

Scientifically, this study contributes to the literature by offering a context-sensitive training intervention model for strengthening teacher digital assessment capacity in migrant education settings. Rather than treating digital assessment as a decontextualized technological innovation, this study shows that effective adoption in CLC environments depends on the interaction between teacher learning, infrastructural realities, and the governance conditions surrounding alternative education for migrant communities. In this sense, the contribution of the study lies not only in reporting a community service practice, but also in providing empirical and conceptual insight into how teacher capacity for digital assessment can be developed in low-resource migrant education contexts.

2. Method

This study was conducted as a training intervention with a descriptive mixed-method evaluation design. The intervention focused on strengthening the capacity of Community Learning Center (CLC) teachers in Tawau, Sabah, Malaysia, to design and implement game-based digital assessment using Blooket [33]. The evaluation component combined quantitative

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baseline and post-activity survey data with qualitative feedback from open-ended responses and short interviews. This design was selected because the program aimed to document contextual needs, training implementation, participant responses, and practical outputs rather than to test causal effects through experimental comparison. Therefore, the study was not designed as a quasi-experiment and did not use a control group or pre-post competency test. In general, the stages of implementing community service are as shown in Figure 1.

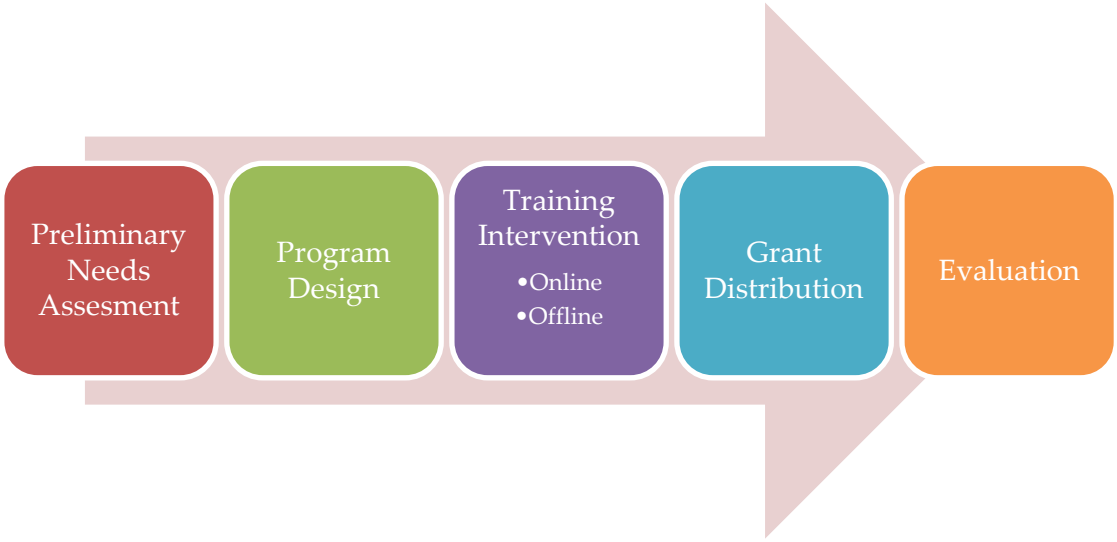

Figure 1. Community Service Activities in Sabah, Malaysia

2.1. Research Design

The intervention design was informed by the Community Tool Box framework, particularly its principles on community needs assessment and evaluation planning [34], [35]. The study was implemented in two linked phases. The first phase was a baseline needs assessment, used to identify teachers' prior experience with digital assessment, school infrastructure, access conditions, and perceived support needs. The second phase was the training intervention, delivered through an online training session and a face-to-face workshop, followed by post-program evaluation and limited infrastructure support to facilitate implementation continuity.

2.2. Setting & Participants

The program was implemented at the CLC in the Tawau area, Sabah, with participants coming from Tawau, Lahad Datu, Kunak, and other plantation districts. CLC refers to Community Learning Centers that primarily serve Indonesian migrant workers' children in Sabah and Sarawak. Established through Indonesia's education support initiatives and cross-border cooperation with Malaysia, CLCs provide basic education (primary and lower secondary) in plantation areas. Despite their important role in expanding access, CLCs continue to face implementation challenges, including limited resources and complex documentation issues affecting some children (e.g., statelessness), prompting calls for stronger formalization and improved program delivery. Participants were recruited using purposive convenience sampling through coordination with partner institutions, especially Sekolah

Indonesia Kota Kinabalu (SIKK), KRI Tawau, and local CLC networks. The inclusion criteria were: (1) active teachers, mentor teachers (*guru pamong*), or supervising teachers (*guru bina*) serving in CLCs in Sabah; (2) involvement in the online training and/or in-person workshop; and/or (3) completion of the baseline needs-assessment survey.

Three participant groups contributed data to the study. First, the baseline needs-assessment survey was completed by 53 CLC teachers. This group provided information on teacher characteristics, school context, digital readiness, and perceived barriers. Most respondents taught in rural schools (70%), while the remainder taught in semi-rural schools (30%). The respondents were predominantly mentor teachers (91%), with a smaller number of supervising teachers (91%). Second, the online training session held on 31 May 2025 involved 117 participants (98 Indonesian citizens and 19 foreign citizens) from multiple CLCs across Sabah. Third, the face-to-face workshop conducted on 9 August 2025 at the Nusantara Hall of KRI Tawau involved approximately 100 participants, primarily mentor teachers and supervising teachers from the Tawau working area.

2.3. Procedures

To improve reproducibility, the intervention procedure can be summarized in six stages. First stage, preliminary needs assessment. Field observations, stakeholder interviews (the Tawau Regional Coordinator, the Head of SIKK, the Head of SIKK Research and Development, and the Education and Culture Attaché of KRI Tawau), and a baseline teacher survey were conducted to map teachers' prior exposure to digital assessment, access to devices and internet, institutional support, and barriers to implementation. This stage identified teachers' needs related to digital technology skills for learning and assessment. The needs assessment served as the foundation for program design and is consistent with the Community Tool Box guidance emphasizing the importance of understanding community context, needs, and resources before implementing an intervention [34].

The second stage was program planning, including the development of an e-module titled "Blooket for Innovative Teachers: A Complete Guide to Game-Based Digital Assessment" as the main learning material, along with technical and logistical coordination supported by KRI Tawau and FGV Holdings Berhad. This was followed by an initial coordination meeting on 20 March 2025. The online meeting with stakeholders ensured the program design matched field needs and logistical feasibility, including the strategic decision to hold the in-person session at the Nusantara Hall of KRI Tawau to reach more participants. The third stage was online training on 31 May 2025 (Figure 2). The session covered digital assessment concepts and hands-on practice using Blooket through live simulations, with the Universitas Negeri Jakarta contributing to the delivery of the digital assessment material.

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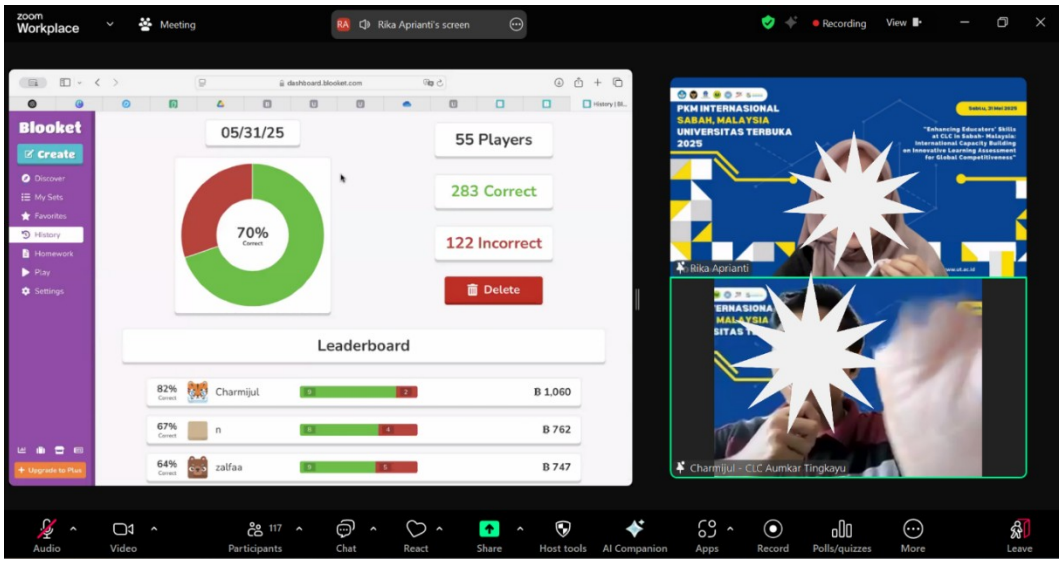

Figure 2. One of the UT lecturers gave a presentation during the online training session

After the online session, an in-person workshop was conducted on 9 August 2025, focusing on hands-on practice and case discussion, and was hosted at the Nusantara Hall of KRI Tawau with operational and facility support from KRI Tawau (Figure 3).

Figure 3. The workshop was conducted interactively

In the fifth stage, the PkM team provided educational grants to support the sustainability of digital learning practices in CLCs. The grants included three ACER X1129 projectors, two HP 15-FC0105AU laptops (Notebook Athlon 7120U), and one Blooket Plus account to support continued use of the digital assessment platform introduced during the program (Figure 4). The grant handover was enthusiastically welcomed by participants and CLC representatives because it helped strengthen learning facilities in plantation environments, where resources are typically limited.

Figure 4. Granting of Blooket application

As the final stage, evaluation data were collected through a post-activity satisfaction survey, participant outputs, and short interviews/comments to document participants' responses, perceived usefulness, and contextual implementation needs. The short interview procedure was semi-structured and brief in nature. It was used to capture participants' reflections on four topics: (1) prior experience in using digital tools for assessment, (2) major implementation barriers in school settings, (3) students' readiness to participate in technology-based assessment, and (4) the kinds of support needed from schools, government, or partner institutions. Because the program was conducted as a community-service intervention, the interviews were intended to enrich program evaluation rather than generate stand-alone qualitative case studies.

2.4. Instruments

To clarify the evaluation process, the study used four categories of instruments. First, Baseline needs-assessment survey. This questionnaire collected participant profile data (e.g., teaching status, school location, prior training experience), access conditions (devices, internet, electricity), perceptions of teacher readiness, student readiness, institutional support, and implementation barriers. The instrument included demographic/contextual items, 25 four-point Likert items, and five open-ended questions. Second, training materials and practice guide. The e-module served as the main instructional material and guided participants through account creation, item design, game settings, and classroom application using Blooket (Figure 5). Third, product-oriented assessment rubric. During the hands-on workshop, participant outputs were reviewed formatively using a simple rubric emphasizing alignment

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with learning objectives, appropriateness of question/task design, clarity of instructions, effective use of Blooket features, and feasibility for low-resource CLC classroom conditions. The rubric was used to provide feedback on participant products rather than as an inferential outcome measure. Fourth, post-program evaluation tools. These consisted of a brief satisfaction survey and short interview/open-ended response prompts focusing on perceived usefulness, positive learning points, suggestions for improvement, and further support needs.

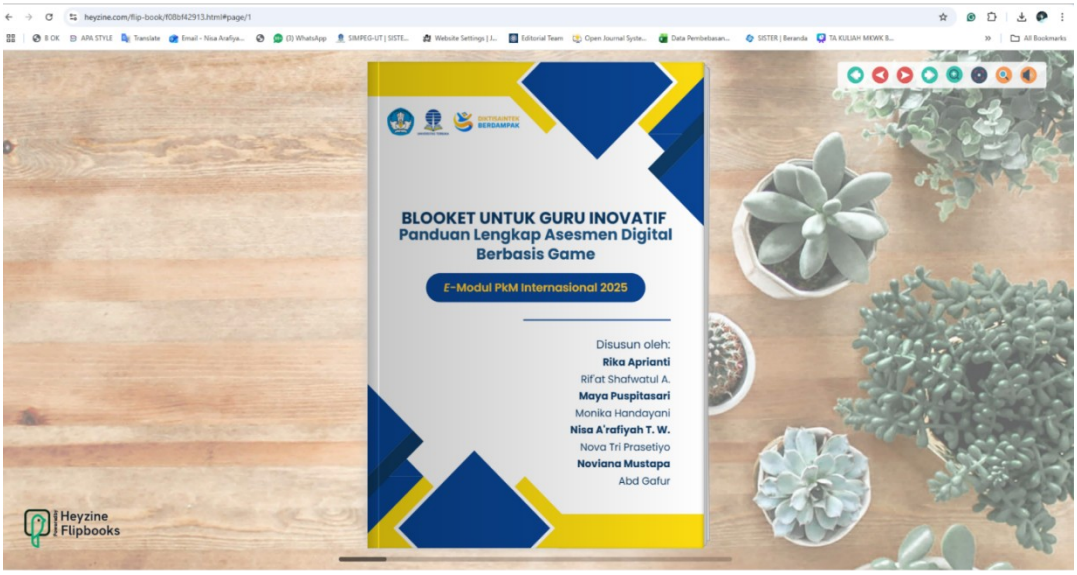

Figure 5. E-module developed as the main training material for game-based digital assessment using Blooket.

Regarding instrument quality, the baseline survey items were developed from the literature on digital assessment literacy, teacher readiness, infrastructure support, and barriers to technology integration, then adapted to the CLC context. Because the survey was used primarily for needs assessment in a community-service setting, formal pre-administration construct validation was limited. However, the internal consistency of the 25 Likert items was checked using Cronbach's alpha, yielding an overall coefficient of 0.895, which indicates strong reliability for descriptive use. Subscale reliability was also acceptable across the dimensions of infrastructure/readiness/support/barriers.

2.5. Data Analysis

Data were analyzed descriptively based on program implementation data. The satisfaction survey results and short interviews were summarized to capture participant feedback on their understanding of digital technology, creativity, and readiness to implement game-based assessments in CLC settings.

To improve analytical transparency, quantitative and qualitative data were analyzed in separate but complementary ways. Quantitative data analysis. Baseline survey and post-activity survey data were tabulated in spreadsheet software and analyzed using descriptive statistics, including frequencies, percentages, and mean scores. The quantitative analysis

focused on participant characteristics, prior training exposure, access conditions, perceived readiness, institutional support, and implementation barriers. Reliability of the baseline Likert-scale instrument was examined using Cronbach's alpha. Because the study did not employ a pre-post competency test or control group, no inferential comparison was conducted.

Qualitative data analysis. Responses from open-ended survey items and short interviews were analyzed using thematic coding. The analysis followed three steps: (1) initial/open coding to identify recurring ideas, (2) grouping of similar codes into broader categories, and (3) synthesis of themes relevant to the study objectives. The main themes that emerged included infrastructure constraints, limited prior training, student access inequality, teacher motivation, and the need for institutional or technical support. These qualitative data were used to enrich interpretation of the descriptive survey results and to explain why a context-sensitive training intervention was needed in CLC settings.

3. Results and Discussion

3.1. Baseline Needs and Context of Digital Assessment in CLC Settings

The baseline needs assessment involving 53 CLC teachers provides empirical evidence that the intervention addressed a real and contextually grounded problem. Most respondents taught in rural schools (70%), while the remainder taught in semi-rural schools (30%). In terms of teaching role, the respondents were predominantly mentor teacher (91%), with a much smaller proportion of supervisor teacher (9%). The respondents came primarily from Indonesia (75%) and Malaysia (23%), with 2% from the Philippines.

The survey also showed that 30 of the 53 teachers had never received formal training related to educational technology or digital assessment. This finding is important because it confirms that digital assessment in the CLC context cannot be assumed as an established teacher competency. Technology use in classroom practice was also uneven: the most common response was "rarely" (23 teachers), followed by "every day" (15), "every week" (10), and "every month" (5). Student access was similarly mixed: 29 teachers reported that students mainly relied on personal devices, 15 reported access to devices provided by the school, and 8 reported no access to digital devices at school. Internet access was available according to 31 teachers, while 20 teachers reported that internet access was unavailable in their school settings.

The Likert-scale baseline data further clarify the pattern of opportunities and constraints. Among the five measured dimensions, teacher readiness showed a moderate mean score (M = 3.00), but this average concealed important variation. Teachers reported relatively high motivation to learn new digital tools (M = 3.45) and relatively strong confidence in using digital tools for assessment (M = 3.23). However, the item on having received sufficient training to integrate technology into assessment received the lowest mean score within this dimension (M = 2.42). This suggests that teacher motivation was not matched by adequate prior professional development. The infrastructure dimension also indicated uneven readiness. The highest score was found for electricity stability during school hours (M = 3.47), but lower scores appeared

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for the adequacy of digital devices (M = 2.79), internet stability (M = 2.75), and student access to digital devices (M = 2.75). In the institutional support dimension, school management support for technology integration was relatively positive (M = 3.28), yet lower scores were found for budget allocation for assessment-related technology (M = 2.60) and periodic evaluation of technology use in assessment (M = 2.60). These findings indicate that willingness to innovate may already exist, but implementation is constrained by systemic support and resource limitations.

The barrier items reinforce this conclusion. Teachers reported that a lack of local training centers (M = 3.04) and the socio-economic conditions of students' families affecting access to technology at home (M = 3.13) were major concerns, followed by the cost of devices (M = 2.96) and limited internet infrastructure (M = 2.92). In other words, the problem faced by CLC teachers is not simply a matter of teacher attitude or individual skill, but a combination of pedagogical, infrastructural, and socio-economic barriers.

The qualitative responses support this pattern. Teachers repeatedly referred to unstable internet access, limited availability of digital devices, and the need for more training and practical support. One respondent highlighted the lack of essential hardware, such as laptops or desktop computers, as well as the absence of internet facilities at school. Another emphasized the need for further training, additional equipment, and better internet connectivity. These responses confirm that the intervention was relevant because it addressed both pedagogical and structural needs rather than merely introducing a new digital tool.

3.2. Implementation Reach and Practical Outputs of the Training Intervention

This community service program enhanced the capacity of CLC teachers in Tawau, Sabah, to design more innovative learning assessments through game-based digital assessment training using Blooket, delivered in two formats (online and in-person). The intervention reached participants through two complementary delivery modes. The online training session held on 31 May 2025 involved 117 educators from multiple CLCs across Sabah, while the face-to-face workshop on 9 August 2025 involved approximately 100 teachers from the Tawau working area. This two-stage format was important because it combined broad initial reach with more intensive practice-based support.

In the online session, the training focused on introducing digital assessment concepts, examples of game-based assessment, and demonstrations of Blooket features. The face-to-face workshop then emphasized practical application, including guided practice, discussion of classroom scenarios, and development of simple assessment activities that could be adapted to CLC classroom conditions. In line with the revised method, participant products were reviewed formatively using a simple rubric covering alignment with learning objectives, task clarity, use of Blooket features, and feasibility in low-resource classroom settings.

Although the study did not include a pre-post competency test, evidence of practice-oriented change can still be observed in the form of participant outputs and implementation readiness. Participants were able to produce or design Blooket-based digital assessment

activities as direct products of the workshop. Thus, the intervention generated more than conceptual exposure; it produced tangible assessment prototypes that teachers could adapt for classroom use. This product-based outcome is consistent with the intervention's practical objective, namely to strengthen teachers' capacity to design and implement game-based digital assessment under contextual constraints.

The sustainability component of the intervention also deserves attention. The team provided limited infrastructure support in the form of three projectors, two laptops, and one Blooket Plus account. While this support was modest, it addressed one of the key findings of the baseline needs assessment: teachers' readiness alone is insufficient when schools face limited devices, unstable access, and uneven resource allocation. In this sense, the intervention did not treat training as a stand-alone event, but as part of a broader support strategy.

3.3. Participant Responses to the Training

Beyond capacity building, the program also supported sustainability by providing infrastructure support (equipment grants and access to a Blooket account). In essence, the main findings can be summarized as follows: First, the training successfully reached CLC educators across locations through an adaptive delivery format; Second, participants produced or designed game-based digital assessments (Blooket) as practical learning outputs; and third, infrastructure support increased the likelihood that digital assessment practices would continue after the program, an especially important factor in resource-constrained settings.

Post-activity feedback, although limited in response rate, provides additional evidence regarding participant perceptions of the training. Of the participants who completed the post-program evaluation form, 12 respondents reported being "very satisfied," 4 reported being "satisfied," and 3 reported being "quite satisfied." This pattern suggests generally positive reception of the training, even though the small number of completed responses means the findings should be interpreted cautiously.

Open-ended responses also showed that participants perceived the training as relevant and practically useful. Several respondents stated that the session expanded their understanding of digital assessment and introduced new ideas for classroom practice. Illustrative comments included: "The training provided many valuable lessons and broadened our understanding of technology-based learning" and "I gained new knowledge about digital assessment using Blooket." Other responses indicated that participants wanted more hands-on practice and follow-up training, suggesting that the intervention was valuable but should ideally be extended through continued mentoring.

These responses are important because they provide empirical support for the claim that the intervention was not merely welcomed at the level of satisfaction, but also perceived as pedagogically relevant. At the same time, the feedback indicates that short-term training alone is unlikely to resolve all implementation barriers. Teachers still requested more practice-oriented sessions, web-based learning strategies, and additional support for attracting students

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through digital learning. This reinforces the interpretation that training is necessary, but not sufficient, for long-term digital assessment integration in CLC contexts.

The finding that digital assessment training is needed in low-resource community education contexts is consistent with the literature on digital education and online assessment challenges in low-resource settings, which are often shaped by limited infrastructure, device access, and uneven institutional support [8], [9]. This interpretation is also consistent with evidence from Malaysia showing that educational access and participation among marginalized non-citizen children are often shaped by structural barriers such as limited digital access, unstable connectivity, and the fragile operational conditions of learning centers. In such contexts, barriers to implementing digital assessment commonly include resource constraints, teacher readiness, and policy or institutional factors [20], as well as risks related to technical issues and unequal learning experiences [21]. Therefore, a program strategy that does not focus only on the "tool" but also considers implementation support is well aligned with these recommendations.

The baseline data strengthen this argument by showing that the main issue in CLC settings is not a lack of teacher motivation, but an uneven relationship between motivation, training opportunity, and implementation support. In this regard, the challenge should be understood not only as a matter of individual teacher readiness, but also as part of a wider educational ecology in which institutional capacity and access conditions strongly influence whether digital assessment can be implemented in practice [4]. Teachers reported high motivation to learn new digital tools, but lower scores on sufficient prior training, budget support, and formal evaluation of technology use. This pattern supports the literature suggesting that teacher digital assessment capacity must be understood as an ecosystem issue rather than as an isolated individual competency [12]–[14], [20].

From a pedagogical perspective, placing game-based digital assessment (Blooket) at the center of the training is in line with Blooket-related studies that highlight the potential of gamification to improve learner motivation and engagement [30]–[32]. These findings are also consistent with research on other digital assessment platforms (e.g., Socrative and Wordwall), which contributes to benefits such as stronger engagement and faster feedback, while also emphasizing that access readiness and instructional strategies are crucial for addressing practical constraints [24], [25]. In this study, the use of Blooket should not be interpreted simply as a tool substitution, but as a pedagogical entry point for strengthening teachers' digital assessment design capacity. The participant products developed during the workshop suggest that teachers were able to translate training content into draft assessment activities suitable for classroom adaptation. This is important because previous studies on assessment literacy emphasize that a central aspect of assessment competence is the ability to design tasks that are instructionally meaningful and contextually appropriate [16]. Thus, even without pre-post scores, the workshop outputs provide limited but relevant evidence of practice-oriented learning.

From an assessment literacy perspective, this program is also relevant to studies emphasizing that teachers' assessment competence, including assessment literacy in digital environments, is a key prerequisite for assessment quality and remains a challenge across contexts [12], [14]. Evidence of cross-country and cross-setting variation in teachers' assessment literacy [19], along with findings of low assessment literacy in specific community contexts [15], further supports the argument that strengthening digital assessment competence among CLC teachers should be treated as a priority.

The findings also extend this literature by showing that in migrant education settings such as CLCs in Sabah, teacher digital assessment capacity is shaped not only by pedagogical competence but also by migration-linked governance gaps and structural resource constraints. This is particularly relevant in Sabah, where alternative learning centers have been described as practical responses to governance gaps in migrant education, meaning that pedagogical interventions must be read alongside broader questions of institutional support and migration-related exclusion [6], [33], [36]. In other words, the challenge of digital assessment in CLCs is inseparable from the broader realities of alternative education provision in marginal and low-resource environments. This helps explain why a context-sensitive intervention model—combining training, practical output production, and limited material support—is more appropriate than a purely technical training model.

Scientifically, the program outcomes can be explained through two main mechanisms. First is a motivational mechanism: gamification in assessment (Blooket) transforms evaluation into an interactive activity, which can increase student participation and engagement, consistent with Blooket research showing gains in motivation and engagement [30]–[32]. Second is an ecosystem mechanism: in resource-constrained contexts, successful adoption of digital assessment depends heavily on infrastructure readiness and environmental support; without these, training may remain at the level of knowledge without real implementation [9], [10], [20], [21]. For this reason, providing post-training access and infrastructure support is an important implication to ensure that learning transfers into practice.

The present findings support the ecosystem mechanism more strongly than any claim of direct competency gain. The baseline survey, participant feedback, and workshop outputs collectively suggest that effective training in low-resource migrant education settings must include at least three elements: (1) practical hands-on design experience, (2) adaptation to limited connectivity and device access, and (3) follow-up support at the institutional level. Therefore, the contribution of this study lies less in proving effectiveness through experimental comparison and more in documenting an empirically grounded intervention model that is feasible within the constraints of CLC environments.

The practical implications for similar community service programs are: First, training design should maintain hands-on instrument production as a core output, because it speeds up skill transfer from training to classroom practice; Second, programs in low-resource contexts should include strategies to mitigate access constraints so that digital assessment implementation does not become uneven [9], [20], [21]; and Third, to improve assessment

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quality over time, follow-up programs can add a reflective practice component (e.g., teacher self-assessment) to strengthen implementation quality [37]. Finally, these findings are also consistent with digital assessment training programs that report teacher capacity gains after structured training and mentoring interventions, reinforcing the rationale that this type of program is well-suited to the CLC context. This study has several limitations. First, the intervention did not use a pre-post competency test or a control group, so the findings cannot be used to claim causal improvement in teacher competence. Second, the post-program evaluation data were more limited than the baseline survey data, meaning that participant satisfaction and perceived usefulness should be interpreted as indicative rather than comprehensive. Third, the product-based evidence generated during the workshop documents teachers' immediate ability to design assessment activities, but does not yet demonstrate sustained classroom implementation or impact on student learning outcomes. Fourth, because the study was conducted within a specific CLC network in Sabah, the findings are context-sensitive and should not be generalized uncritically to all migrant education settings.

Despite these limitations, the study still offers meaningful value by providing empirical baseline evidence, documenting a replicable intervention process, and identifying the contextual conditions that shape digital assessment adoption in low-resource migrant education settings. Future studies should extend this work by incorporating classroom observation, longitudinal follow-up, and more robust measures of teacher competency change and student learning outcomes.

4. Conclusion

Strengthening teacher digital assessment capacity in migrant education settings requires a context-sensitive approach that goes beyond introducing digital tools alone. In the CLC context of Tawau, Sabah, the findings indicate that teachers' motivation to adopt digital assessment was constrained by limited prior training, uneven infrastructure, and insufficient institutional support; therefore, the intervention combined training, hands-on practice, and limited material support to address both pedagogical and contextual barriers. Scientifically, this study contributes to the literature by showing that teacher digital assessment capacity in low-resource migrant education settings should be understood as an ecosystem issue shaped by the interaction of teacher competence, infrastructural conditions, and governance-related constraints. This implies that policy and program efforts to strengthen digital assessment in CLCs should integrate teacher development with minimum infrastructure support, institutional coordination, and sustained follow-up. As this study did not employ a pre-post competency test or longitudinal observation, future research should examine classroom implementation over time, measure changes in teacher competence more systematically, and assess the effects of game-based digital assessment on student engagement and learning outcomes across different CLC contexts.

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