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CO-DESIGNING CULTURALLY RESPONSIVE DIGITAL SOLUTIONS FOR INCLUSIVE EDUCATION: A QUALITATIVE CASE STUDY AMONG ORANG ASLI COMMUNITIES IN SELANGOR

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Digital Solutions for Inclusive
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Communities in Selangor**

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Co-Designing Culturally Responsive Digital Solutions for Inclusive Education: A Qualitative Case Study Among Orang Asli Communities in Selangor

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ABSTRACT

This study examines how digital inclusion impacts quality education among the Orang Asli communities in Selangor. Although national policies such as the Malaysia Education Blueprint 2013-2025 and other plans aim to resolve the digital gap among the rural communities, many rural Indigenous learners continue to experience limited internet connectivity, lack of devices, and inadequate support. Using the photovoice method grounded in participatory lens between researchers and the Orang Asli communities, the research captures the lived experiences of the Orang Asli households as they navigate online learning and digital poverty. According to findings, there is a struggle in internet access as its instability often disrupts learning and deepens inequality causing students to leave education early and pursue work in order to sustain themselves financially. At the same time, their narratives also reveal how spaces like town halls and simple tools such as books, light, and roads contribute to empower connection and creativity in learning. Overall, the study highlights that digital inclusion for the Orang Asli communities is not just mere technology but rather creating conditions that support their learning, culture, and well-being in a digital world.

Keywords: Digital literacy, education, Indigenous, culture, community psychology

INTRODUCTION

Malaysia's commitment to the Sustainable Development Goals (SDGs) is centred on building an inclusive society guided by the 2030 Agenda's transformative promise to leave no one behind. This is especially the case with respect to its commitments towards SDG 4 (Quality Education), which aims to ensure equal access to education for all. National policies like the Malaysia Education Blueprint 2013–2025 and various digital inclusion initiatives seek to provide all Malaysians with the connectivity and tools needed for full participation in education and the digital economy. Yet, despite these commitments, persistent disparities remain between policy aspirations and the lived realities of marginalised communities, particularly the Orang Asli (Sawalludin et al., 2020; Hashim et al., 2011).

During COVID-19 school closures, the national school attendance rate fell to 81.4%, as many Orang Asli children were unable to attend online classes due to the lack of internet access and digital devices, revealing a persistent digital divide (UNICEF Malaysia, 2023). Little is known about how digital poverty, like inadequate infrastructure, connectivity, and devices, impacts the educational experiences of Orang Asli communities. Such conditions reflect a deeper issue of digital poverty in that technological infrastructure, affordability, and accessibility collectively shape educational exclusion. Despite numerous national efforts like the Twelfth Malaysia Plan (2021–2025), the Malaysia Digital Economy Blueprint (MyDIGITAL), and the Universal Service Provision (USP) initiatives aimed at expanding rural broadband access, the experiences of Orang Asli learners in navigating the digital divide remain underexplored, leaving a significant gap in understanding how digital inequities affect Indigenous education.

Despite the country's policy commitments to promote digital inclusion and quality education, rural and Indigenous communities, including

the Orang Asli in Selangor, continue to remain excluded from digital-education opportunities. Digital poverty is a key barrier along with unreliable internet and costly devices, which undermines Malaysia's ability to fulfil these targets.

A significant gender divide further widens this gap (Zainol & Karim, 2024; Jegatesen, 2017). Orang Asli women and girls receive less encouragement to develop digital skills and have fewer opportunities to access online resources than their male counterparts (Ahmad et al., 2019). According to Bala and Tan (2021), 42% of Orang Asli women had only less than 3 years of primary education as compared to 57% of their male counterparts across 1,047 samples at Balar, Gob, Lenjang and Sinderut settlements. At the secondary level of schooling, 63% of females and 69% of males reported that they attained education up to Form 3 or below. Such disparities restrict women's access to technology-enabled learning and digital literacy, undermining SDG 4's call for equitable access to quality education, relevant skills, and gender parity in learning, particularly for Indigenous peoples. Additionally, according to Malaysia's 2025 Voluntary National Review, which reports current national SDG progress, SDG 5 (Gender Equality) is one of the nation's weaker Goals.

Mainstream curricula often disregard Indigenous cultural contexts, making learning disengaging for Orang Asli students (Abd Karim et al., 2021). Consequently, students struggle to relate classroom content to their lived experiences, leading to low motivation, absenteeism, and early dropouts. As noted by Bernama (2022), 42.29% of Orang Asli children fail to complete secondary education, and only about 2% progress to tertiary levels. These figures underscore the fact that culturally alien schooling environments continue to marginalise Indigenous learners despite national inclusion efforts. Excluding this, factors such as the need to help families with work, parents' negative

view on education, and long distances to secondary schools also contributed to the high dropout rates (Nor et al., 2011; Deli & Yasin, 2016; Bernama, 2022). Recently, the Comprehensive Special Model Schools (K9 and K11), a commitment of the Education Ministry, managed to reduce the dropout rate by keeping the students from rural and remote areas in the same educational setting (Bernama, 2022).

Nevertheless, these challenges highlight a gap between policy and practice, emphasising the need for a deeper, community-centred understanding about the impact of digital poverty on Orang Asli education. Without such insight, policies risk failing to serve the communities they aim to uplift. This study seeks to bridge that gap, informing more inclusive digital education strategies.

Recognising that effective solutions must engage those most affected, this study adopts a participatory co-design approach grounded in Indigenous research methodologies. Co-design has been increasingly recognised as a transformative method for research with marginalised populations (Moll et al., 2020; McBride et al., 2017), as it positions community members as active co-creators of knowledge rather than passive subjects.

Understanding digital inclusion through an Indigenous and community-based lens is therefore essential. For the Orang Asli, digital participation extends beyond access—it relates to empowerment, belonging, and the ability to sustain learning within their cultural and social realities.

Drawing on participatory, co-designed, and Indigenous research approaches (Moll et al., 2020; McBride et al., 2017), three research objectives were formulated:

1. Collaboratively document and interpret the lived experiences of Orang Asli students, parents, educators, and community leaders with respect to their digital access, usage, and challenges.
2. Explore how digital poverty, gender disparity, and the lack of culturally responsive education intersect to shape Orang Asli students' access to quality education, using a co-design framework that privileges community insight and local knowledge.
3. Co-develop, in partnership with Orang Asli community members, a set of qualitative, evidence-based insights and recommendations to inform actionable, culturally responsive policies and programmes.

LITERATURE REVIEW

Conceptualising Digital Poverty and Educational Inclusion

Digital connectivity has become a prerequisite for full participation in modern education globally, yet access remains profoundly uneven, especially in rural areas. The term “digital divide” traditionally refers to the gap between those who have access to ICTs and those who do not. Contemporary research, however, emphasises that the divide is multidimensional, encompassing disparities in access, skills, motivation, and meaningful use rather than connectivity alone (Lythreath et al., 2022). These dimensions form interlocking layers that determine how individuals convert technological access into tangible educational and social benefits.

A related concept, digital poverty, describes not only a lack of devices or broadband but also the inability to use technology effectively, reliably, and affordably to achieve educational or social goals (Heeks, 2022). Within this framework, meaningful connectivity—defined by the frequency, quality, and reliability of digital engagement—offers a

more accurate measure of digital inclusion than raw coverage statistics (Gong, 2020). As Malaysia transitions toward a high-income digital economy, it is important to recognise that giving out devices alone does not ensure inclusion. Deeper social and cultural barriers still limit real participation.

Educational research increasingly situates the digital divide within the broader landscape of inequality. Students from lower-income or marginalised communities are less likely to possess both material resources (e.g. devices and stable internet) and digital literacies needed for sustained learning (Miah, 2023). The lack of these digital capabilities undermines cognitive engagement, self-efficacy, and motivation which are psychological factors central to learning persistence. Consequently, digital poverty in education functions as both a technological and psychosocial form of exclusion.

For Malaysia, achieving SDG 4 therefore requires not only infrastructural investment but also policies that strengthen human capital, particularly in rural and Indigenous settings where digital-capability gaps are most pronounced.

The Digital Divide in Rural and Indigenous Contexts in Malaysia and Southeast Asia

Across Southeast Asia, digital exclusion follows lines of geography, income, and ethnicity. Rural and Indigenous populations face disproportionate barriers to reliable internet access, device ownership, and digital literacy. These structural inequalities have deep historical roots in uneven infrastructural development and policy prioritisation. In Malaysia, despite multiple digital-inclusion programmes under the Twelfth Malaysia Plan and JENDELA initiatives, the digital divide remains entrenched in remote areas (Dawood et al., 2019).

Empirical studies consistently document these disparities. Research among native communities in Sabah demonstrate that inequality in digital access persists across all four of van Dijk's dimensions—motivation, physical access, skills, and usage—resulting in low sustained engagement with online platforms (Fang et al., 2022). Similar findings emerge from the rural northern peninsula, where infrastructural limitations and affordability continue to impede everyday usage despite ICT initiatives (Dawood et al., 2019).

At the higher education level, Malaysian university students still experience a three-level digital divide—material access, skills, and usage—during online learning, with students from the bottom 40 per cent (B40) of households being the most disadvantaged (Subramaniam et al., 2024). Among Orang Asli and other Indigenous learners, connectivity issues are compounded by cultural and linguistic alienation from mainstream digital content (Abdul Razak, 2025; Angit & Jarvis, 2024).

Parallel patterns appear across Southeast Asia. In Indonesia and the Philippines, rural and Indigenous regions lag behind national connectivity targets, and digital-literacy deficits hinder uptake even when networks exist (Abd Rashid et al., 2025). These regional parallels highlight that digital exclusion is not merely technological but sociocultural: digital infrastructures reflect the same hierarchies that structure economic and ethnic marginalisation.

Collectively, these findings position Malaysia's Orang Asli as emblematic of the region's broader challenge, ensuring that digital transformation does not replicate colonial and urban-centric inequities. Bridging this divide requires context-specific approaches, infrastructure investment as well as culturally responsive pedagogy and community participation.

The COVID-19 Stress Test: Unequal Impacts on Learning

The abrupt shift to remote and hybrid learning during the COVID-19 pandemic functioned as a stress test for educational systems worldwide, exposing latent digital poverty and magnifying inequalities. In Malaysia, the pandemic revealed stark disparities in students' capacity to maintain learning continuity, particularly in marginalised rural and Indigenous contexts.

Research from rural Sabah illustrates this vividly. In a survey of 233 secondary school students in Tawau, Sabah, about six months into mandated online learning, students with lower attendance in online classes rated the effectiveness of those classes lower. Moreover, lack of home devices was significantly associated with lower perceptions of learning viability (Surienshah, 2021).

Parallel patterns were found in higher education. Subramaniam et al. (2024) studied Malaysian university students during the pandemic, applying the three-level digital divide model. They found that the divide persisted across all levels, and underprivileged students were disproportionately marginalised in terms of access and student satisfaction.

The B40 student population in Malaysia faced acute challenges. In qualitative interviews, Ali et al. (2024) documented their struggles which included unreliable internet, insufficient devices, and communication barriers. These challenges not only affected academic performance but also emotional well-being and motivation to persist in online learning.

On the institutional side, studies of online learning across Malaysia during the COVID-19 period highlight how infrastructural capacity, teacher readiness, and policy support varied across regions. Hong

(2024) reports that social support and robust infrastructure were key predictors of successful transitions to online modalities in Malaysian higher education institutions (HEIs).

In broader analyses, the ecological technology-subsystem approach applied to Malaysian schools frames digital learning during COVID as a system of interacting levels: home environments (microsystem), social mediation (parents, teachers as bridges), and national policy or infrastructure (macrosystem). These levels co-shape whether students can cross digital learning boundaries (Samsudin, 2021)

Beyond Malaysia, cross-national studies also confirm that vulnerable students (e.g. low-income, remote, and Indigenous) were disproportionately excluded from synchronous learning during the pandemic. For instance, Norman et al. (2022) examine vulnerable students globally and argue that limited access as well as differential usage of technology led to widening educational disparities in emergency remote teaching.

These empirical findings show that COVID-19 did more than create temporary disruption—it converted latent digital poverty into active educational exclusion for marginalised groups. Orang Asli communities, whose connectivity and resources were already constrained before the pandemic, likely bore this compounding burden most severely. The next section will narrow the lens further to examine how digital poverty and culturally responsive design intersect within Orang Asli educational contexts.

Culturally Responsive Education and Indigenous Learning

While the COVID-19 pandemic exposed infrastructural inequities, it also magnified the cultural disconnection embedded in Malaysia's mainstream education system. For many Orang Asli learners, digital

exclusion is not only technological but also pedagogical—arising from curricula, platforms, and languages that do not reflect their lived realities. Research on Indigenous education in Malaysia highlights how Western-centric content and Bahasa Malaysia-only delivery marginalise Indigenous identities, eroding motivation and sense of belonging (Rosnon, 2016).

Culturally responsive education (CRE) challenges these assumptions by embedding local knowledge, languages, and values in teaching practice. Internationally, CRE has been shown to improve engagement and achievement among marginalised learners by aligning learning processes with students' cultural frames of reference (Gay, 2018). In Indigenous contexts, this approach affirms that education is not merely the transfer of knowledge but a relational process rooted in community, land, and collective well-being (Villegas & Lucas, 2002).

In Malaysia, studies confirm that when instruction draws on Indigenous epistemologies, attendance and retention improve. For example, Abd Karim et al. (2021) found that integrating Orang Asli oral traditions and place-based knowledge into science and language lessons strengthened students' engagement and pride in identity. Likewise, Angit and Jarvis (2024) report that digital tools designed with culturally relevant narratives and bilingual interfaces increased Orang Asli students' participation in online activities. They conclude that the absence of culturally grounded digital content leaves Indigenous learners as "peripheral participants" in the digital classroom.

The concept of cultural responsiveness extends naturally into the digital domain. Scholars note that technology integration without cultural adaptation risks replicating historical colonial hierarchies in new forms (Jegatesen, 2017). For Indigenous users, platforms that are developed externally may impose unfamiliar epistemic frameworks,

privileging linear text-based learning over storytelling, oral exchange, or communal reflection which are pedagogies central to many Orang Asli communities (Angit & Jarvis, 2024).

Globally, Indigenous scholars advocate a “Two-Eyed Seeing” approach that integrates Indigenous and Western knowledge systems to co-create curricula, research, and technology (Chilisa, 2019). Within this framework, digital inclusion is meaningful only when technology becomes a conduit for cultural continuity rather than assimilation. Culturally responsive digital education for Orang Asli communities, therefore, must foreground language preservation, community consultation, and collective authorship in both content and platform design.

This recognition provides a conceptual bridge to the co-design methodologies detailed in the next section. By centring Orang Asli voices in shaping digital education strategies, co-design not only rectifies technological inequity but also rebalances epistemic power, ensuring that educational innovation advances cultural sustainability alongside connectivity.

Co-Design and Indigenous Research Methodologies

Extending the discussion on culturally responsive education, an equally vital shift concerns how research and digital innovation are undertaken with Indigenous communities. Traditional top-down approaches often reproduce inequities by treating participants as passive subjects rather than partners in knowledge creation. In contrast, co-design and Indigenous research methodologies emphasise reciprocity, respect, and relational accountability which are principles that anchor ethical, context-sensitive inquiry (Chilisa, 2019). Co-design entails community participation across every research stage—problem identification, idea generation, and

implementation—ensuring that solutions are culturally grounded and locally owned. Within Indigenous contexts, it is both a methodological and political act that promotes self-determination and epistemic justice. Louis (2007) argues that Indigenous methodologies must centre benefit and accountability to the community rather than extractive data collection.

A guiding paradigm for such collaboration is the “Two-Eyed Seeing” (Etuaptmuk) framework, which invites researchers to “see with one eye” the strengths of Indigenous knowledge and “with the other” the insights of Western science, using both together for mutual benefit (Bartlett et al., 2012). Subsequent integrative reviews confirm that Two-Eyed Seeing builds co-learning relationships and legitimises Indigenous epistemologies within mainstream research processes (Wright et al., 2019).

In Malaysia, participatory approaches are increasingly evident in Indigenous education research. Angit (2020) employed photovoice with Orang Asli students, showing how visual storytelling enabled participants to express educational realities in their own cultural terms. More recently, Angit and Jarvis (2024) demonstrated that involving Indigenous teachers and parents in digital-education design improved cultural relevance and strengthened community trust (Angit & Jarvis, 2024). Parallel efforts to enhance digital inclusion, such as establishing community-managed telecentres among the Orang Asli, show that equitable access must integrate technical usability with social and cultural sustainability (Bala & Tan, 2021).

Collectively, these approaches translate cultural responsiveness into methodological practice. Co-design transforms research from observation to collaboration, ensuring that technologies and educational strategies are grounded in Indigenous worldviews,

languages, and aspirations. For Malaysia's Orang Asli, co-design represents not only a route toward equitable digital participation but also a framework for participatory policy development that sustains cultural identity and local agency in the digital era.

METHODOLOGY

This study adopted a qualitative case study design grounded in Indigenous methodologies and co-design principles. Indigenous methodologies prioritise Indigenous worldviews and ethical research engagement (Chilisa, 2019; Smith, 2012), ensuring meaningful representation of Indigenous stakeholders (Louis, 2017). In Malaysia, Indigenous perspectives in education remained underrepresented (Angit & Jarvis, 2024; Rosnon, 2016). Integrating these methodologies fostered equitable power dynamics and a more accurate understanding of Indigenous education challenges.

Given the diverse contexts of Indigenous communities, Indigenous methodologies often blend with conventional methods (Chilisa, 2019; Kovach, 2009). This study applied the "Two-Eyed Seeing" approach, integrating Indigenous and Western research frameworks to ensure cultural relevance (Chilisa, 2019). Co-design principles are aligned with Indigenous consultation practices, emphasising respect, reciprocity, and collective interests (Hart, 2010; Nicholas, 2022).

1. Participatory Co-Design Approach

A core feature of this project was its commitment to genuine community participation. An Orang Asli collaborator, with lived experience and deep local knowledge, was an integral part of the research team. This collaborator actively participated in developing the research questions, ensuring that they emerged organically from community-identified priorities. The co-design process was iterative and involved the following steps:

Initial Consultation

Preliminary meetings were held with community leaders, educators, and the designated Orang Asli collaborator to discuss challenges and potential research directions. These sessions helped establish trust and ensured that the research framework was culturally grounded.

Co-Development of Research Questions

Through a one-day guided workshop, participants collaboratively refined the research questions. This ensured that the study's focus was both locally relevant and reflective of the community's aspirations, while still aligning with broader policy objectives.

Iterative Feedback Loops

Regular feedback sessions were scheduled throughout the project, allowing adjustments to be made in response to emerging findings and community input.

2. Qualitative Data Collection

To conduct ethical data collection with the Orang Asli communities, community leaders were given an informed consent as well as an explanation of the study's purpose. Researchers were trained in cultural sensitivity to ensure respect for the community's values and traditions.

Focus Group Discussions (FGDs)

To understand the current digital experiences of the Orang Asli community, this study conducted a one-hour interactive focus group discussion (FGD) that explored perceptions of digital access, influence of gender, and educational quality. The FGD provided a broad range of insights (Hennink, 2013) and were held in comfortable settings to ensure participants felt safe and included. Written and verbal consent forms were distributed and communicated among the participants for

mindfulness of power dynamics and avoidance of any form of exploitation. Participants were also informed that the discussion will be recorded, transcribed, and analysed. In regard to ethical considerations, participants were notified that their identities will remain anonymous.

Findings from the discussions were shared with the community for feedback and validation as part of the triangulation process, ensuring that their perspectives were accurately represented.

Photovoice

Drawing on the photovoice concept introduced by Wang and Burris (1997), this study utilised the method to provide a platform for participating Orang Asli community members to document and share their lived experiences. Since its introduction, photovoice has been widely used in Indigenous research and is recognised as an empowering method that allows participants to visually represent their realities, express their voices, and influence social change (Jennings & Lowe, 2013; Castleden et al., 2008; Powers & Freedman, 2012).

In the Orang Asli context, Angit (2020) employed photovoice to capture the lived experiences of Orang Asli students in Peninsular Malaysia. Drawing on these prior models, the photovoice project in the present study was conducted in three stages:

| STAGE | ACTIVITY |
|-----------------------------------|---|
| Preparation | <ul style="list-style-type: none"> • A photovoice workshop was co-organised by the research team and community members. • A short photovoice training was provided to participants. • Participants and the research team co-developed a guideline for the photovoice project. |
| Reflection and Documentation | <ul style="list-style-type: none"> • Participants took photos documenting their lived experiences and kept journal entries describing the captured moments. In line with Indigenous oral traditions, journal entries were also audio-recorded when appropriate. |
| Sharing and Collective Reflection | <ul style="list-style-type: none"> • Participants shared two selected photos in a sharing circle. • Selection of main photos was carried out by participants to ensure that the issues were presented from their perspectives. Additional photos selected by researchers were also discussed in the sharing circle. |

Community members used their existing devices to visually document their daily interactions with digital technology. These images served as participatory data, and when accompanied by participant narratives, provided tangible evidence of both challenges and creative adaptations in technology use (Sutton-Brown, 2014). Participants were also informed that their faces will not be revealed, and their privacy will not be breached.

Ethnographic Observation

Immersive fieldwork captured contextual details of digital interactions in everyday life. The study adopted a realist ethnographic approach, where accounts of situations or interactions were observed on-site and typically reported from a third-person perspective (Creswell & Poth, 2016). A digital literacy and entrepreneurship workshop was conducted, during which researchers unobtrusively observed participants' interactions, engagement, and responses to digital tools and content. Detailed field notes were taken on interpersonal interactions, non-verbal cues, group dynamics, and challenges faced. Multiple-investigator triangulation was undertaken by reconvening to validate each other's observations, ensuring that behaviours and contextual nuances were accurately captured.

Data Analysis

All qualitative data were analysed using Braun and Clarke's (2006) thematic analysis, guided by the principles of Indigenous research methodologies. Codes were generated from FGD transcripts, photovoice narratives, and ethnographic field notes. The analysis emphasised the interconnectedness of digital poverty, gender disparities, and educational challenges, ensuring that local voices guided the interpretation of data.

Iterative member-checking sessions were conducted to validate findings with community members, and multiple-investigator triangulation was employed to ensure the validity and credibility of the analysis.

FINDINGS

FGD - Thematic Analysis

This thematic analysis reports the lived experiences of Orang Asli families and children, navigating online learning, educational motivation, and daily livelihood pressures. Four overarching themes were found: 1) Technological barriers to consistent learning, 2) Evolving attitudes toward learning, 3) Burden of everyday survival on parental involvement, and 4) Economic pressures and the abandonment of schooling. These themes reflect the challenges that intersect in shaping children’s participation and persistence in education.

Table 1. Thematic Analysis of Focus Group Discussion

| THEMES | CATEGORIES | CODES |
|---|--|--|
| Technological Barriers & Distractions to Consistent Learning | <ul style="list-style-type: none"> • Unstable internet connection • Time wasted waiting for signal • Frustration when unable to attend online class | <ul style="list-style-type: none"> • Waiting for internet takes time • Need to go up hill / outside / window for connection • Angry when they cannot study • Playing phone while waiting • Watching dramas on YouTube because many episodes |
| Evolving Attitudes Toward Learning | <ul style="list-style-type: none"> • Older kids having interest in following lessons • Declining motivation in | <ul style="list-style-type: none"> • Older kids’ desire of not wanting to be left behind in studies • Angry when they cannot study |

| THEMES | CATEGORIES | CODES |
|--|---|---|
| | secondary school <ul style="list-style-type: none"> • Resistance in studying at a young age | <ul style="list-style-type: none"> • Lose interest in online learning • Too lazy to study, throw bags after school |
| Burden of Everyday Survival on Parental Involvement | <ul style="list-style-type: none"> • Packed daily schedules • Limited time to monitor children's studies • Household chores and work as competing priorities | <ul style="list-style-type: none"> • Mother cooks, folds clothes, taps rubber • Parents' packed schedule (work and household chores) • Parents wake up very early (5-6am) for work • Parents have no time to supervise children's learning • Children do ABC/homework but only briefly before play |
| Economic Pressures and the Abandonment of Schooling | <ul style="list-style-type: none"> • Children irregularly attending school • Dropping out/refusing school • Transition to farm work or paid labor | <ul style="list-style-type: none"> • Sometimes go to school, sometimes don't • Lazy to study • Claim homework is done but not checked • Transition into farm work (starfruit farm, rubber tapping) |

| THEMES | CATEGORIES | CODES |
|--------|---|--|
| | <ul style="list-style-type: none"> • Early independence from formal learning | <ul style="list-style-type: none"> • Parents accept children's withdrawal from school |

Technological Barriers to Consistent Learning

This theme captures how unstable digital infrastructure obstructs children's access to consistent online learning. Participants described unstable internet connections, where the signal fluctuated unpredictably with *one moment there is [internet], one moment there isn't*. This instability led to significant time wasted waiting for a signal, with some children and parents *climbing hills, standing by windows, or waiting outside the house* just to get connection.

When they are free, children often fill their time by playing on their phones or watching dramas on YouTube, diverting attention away from learning. The frustration of missing online classes or being unable to watch YouTube generated emotional strain for some children, with some expressing anger or helplessness. This theme highlights the digital divide as a structural barrier, where unreliable connectivity undermines continuity, focus, and emotional well-being in pursuing equitable education.

Evolving Attitudes towards Learning

The second theme reflects a decline in academic motivation as children grow older. While some older students showed interest in following lessons, this enthusiasm often diminished over time, particularly upon entering secondary school. Parents noted that younger children became *angry* when unable to study online, yet over time many lost interests or resisted studying altogether.

Behaviourally, this manifested as laziness, avoidance, or dismissive attitudes toward homework—children would *throw their bags after school to play* or claim to have completed their work without parents' verification. The progression from early eagerness to apathy led to disengagement, suggesting that inconsistent access, limited parental supervision, and reduced learning rewards contribute to long-term motivational decline.

Burden of Everyday Survival on Parental Involvement

Parents' heavy workloads and household responsibilities is a major theme that illustrates the limitation of their capacity to supervise and support their children's education. Many parents reported packed daily schedules, waking as early as 5 or 6 a.m. to cook, work in farms, and rubber tapping before returning home to continue domestic chores. One participant managed dual work commitments—teaching kindergarten followed by tuition classes – leaving little time or energy to guide their children's learning.

As a result, children were often left to study briefly or complete basic homework like *the ABCs* before being allowed to play. Parental fatigue and the necessity to prioritise survival needs over educational support reveal a pattern of unintentional educational neglect—not from disinterest, but from systemic overwork and limited resources. This theme underscores how economic survival competes with educational attention, shaping the family's capacity for long-term academic engagement.

Economic Pressure and the Abandonment of Schooling

The final theme highlights how economic hardship and family labour needs drive children's early withdrawal from formal education. Reports of irregular school attendance, refusal to attend classes, and eventual dropout were common. Some children justified their

absence with excuses such as *lazy to study* or *homework already done* while parents gradually accepted these patterns as inevitable.

Several families described their children's transition from schooling to agricultural or paid labour, such as working at *starfruit farms* or *rubber tapping*, signalling an early shift from learning to livelihood. This transition also reflected early independence from formal education, as children's identities became tied to work rather than schooling. Thus, the theme illustrates how structural poverty, limited opportunity, and low educational motivation converge, leading to a normalisation of early school withdrawal and child labour participation.

Summary

Overall, these themes portray an interconnected system of educational disruptions. Technological barriers limit access. Declining motivation corrodes persistence. Parental workload reduces supervision. Not to mention, economic necessity encourages early exit from schooling. The findings suggest that the continuity of learning is deeply embedded within broader socioeconomic realities, where education competes with survival, connectivity, and emotional endurance.

Photovoice Narrative Analysis

The photovoice findings reveal how the Orang Asli villagers engaged with digital technologies amid their everyday lives while pursuing education, convenience, and connection. Through their perspectives, participants highlighted the persistent structural and infrastructural barriers that shaped their digital experiences as well as the possibilities enabled by digital tools. The stories told consisted of aspiration, adaptation, and a spirit of resilience, illustrating how access

to digital resources remains both empowering and constrained within the community's sociocultural and economic contexts.

Digital Adaptation and Connectivity as a Lifeline

Respondent 1 demonstrated digital adaptability, using her phone for coding and guitar tutorials when computers were unavailable (See Figure 1 & 2). Her photograph of using a mobile phone to complete computer science assignments encapsulates a creative opportunity to infrastructure scarcity—the lack of computers at home or school labs accessible outside school hours. Despite challenges, Respondent 1 demonstrated that digital inclusion is not merely about access, but about meaningful use—the ability to learn, create, and self-teach even in constrained conditions.

Figure 1. Using smartphones for coding

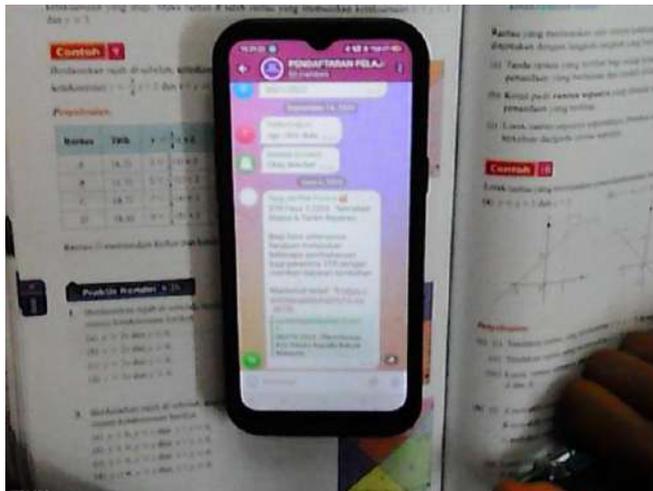


Figure 2. Using smartphones to self-learn guitar



Similarly, others turned to online platforms such as YouTube and Telegram to acquire knowledge, support their children's education, or sustain social and emotional well-being. Even when connectivity was unreliable, participants persisted by climbing hills, waiting for signals, or adjusting their schedules to access faster internet at night.

Figure 3. Using Telegram group chats for knowledge exchange



Their narratives reveal how digital connectivity functions not merely as technology but as a lifeline of inclusion, enabling Orang Asli individuals and families to maintain learning, connection, and hope within structurally constrained environments.

Broadening the Meaning of Technology and Empowerment

For the Orang Asli participants, the notion of technology extends beyond digital devices. To them, technology is also a symbol of comfort, mobility, and infrastructure, such as a simple fan and a paved road (See Figure 4 & 5). Respondent 2's perception of a fan and a paved road as forms of technology shows how the Orang Asli view modern life—where comfort, easy access, and the ability to move around are important signs of progress. Similarly, Respondent 7's images of a light bulb, town hall, and book represent not just the progression and convenience of learning, but they also reflect a deep gratitude for resources that were only recently made available to them. These are everyday items that many modern communities take for granted, but for the Orang Asli, they symbolise progress, inclusion, and newfound dignity.

Figure 4. Perception of a fan as a form of digital technology



Figure 5. Perception of a newly paved road as “digital technology” in advancement



These narratives collectively illustrate that for the Orang Asli, being included in technology means more than just using digital devices. It also involves having good roads, electricity, education, and community spaces that help them learn, connect, and make their own choices in today's digital world.

Digital Mediation of Motherhood and Education

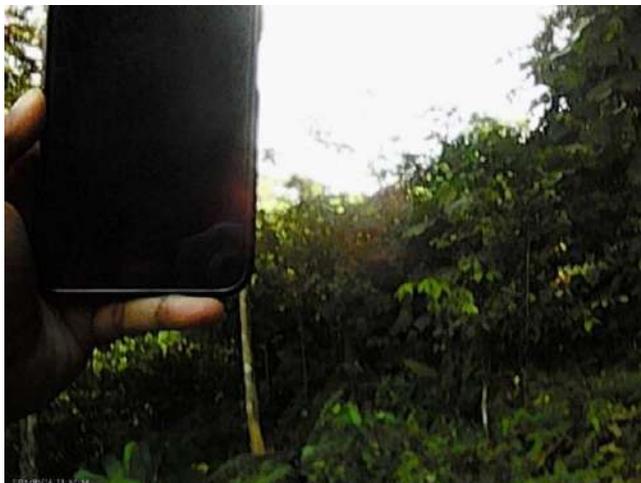
Respondents 3 and 4 revealed the emotional labour of mothers navigating digital learning in rural conditions. YouTube has become both a tool for education and childcare, enabling access to English lessons and serving as an entertainment medium through cartoons like Upin & Ipin. Sometimes, YouTube and smartphones serve as a distraction for the children. Besides providing entertainment and supporting the children's education, it also allowed parents brief moments of rest.

Figure 6. Children distracted with phones



Yet, slow internet connections and the need to climb hills for connection can result in physical and emotional exhaustion, as mothers struggle to balance educational responsibilities with household duties (See Figure 7). Despite the inconvenience, Respondent 4 described mixed feelings—frustration in climbing hills intertwined with moments of enjoyment in nature.

Figure 7. Finding connection in the woods



Both mothers' narratives illustrate the benefits and limits of technology. The phone serves as an educational and entertainment device; however, lack of connectivity highlights poor digital access that adds to their exhaustion. The phone also becomes their "television," a rare window to the outside world. Another respondent expressed that phones have become their *nyawa* or life.

Summary

Overall, this photovoice project highlights that digital inclusion for the Orang Asli is closely tied to their everyday lives and relationships. Even with ongoing issues like weak internet and financial struggles, they continue to adapt by using technology to learn, stay connected, and manage daily challenges. For them, digital inclusion goes beyond simply having devices or internet access, but about finding ways to make technology useful and meaningful within their rural realities.

DISCUSSION AND IMPLICATIONS

Findings revealed that digital inclusion among the Orang Asli is far more complex than simply having access to devices or the internet. By definition, digital inclusion reflects meaningful use—how individuals adapt technology to meet practical and social needs despite structural constraints (Selwyn, 2010; van Dijk, 2020). To the participants, technological usage is woven into their daily lives such as learning, work, and family life. One of the participants relied on their phone for coding and guitar tutorials, illustrating how digital tools can foster creativity and independent learning even in resource-limited contexts. This act of adaptation reflects resilience by negotiating the limits of connectivity to sustain participation in education and self-improvement.

For the Orang Asli community, their definition of digital technology also comes with cultural meanings and modern functionality. For

example, Respondent 2's photographs of a fan and a paved road reveal how technology is not only understood as digital devices but as symbols of comfort, access, and mobility which are fundamental to well-being and progress in the community. This interpretation echoes Indigenous perspectives that view modernity as relational, where tools and infrastructures are valued for how they enhance collective life rather than for their technical sophistication alone (Smith, 2012; Nakata, 2007). Similarly, images of light bulbs, books, and the recently built town hall taken by another participant underscore how access to basic infrastructure and literacy fosters empowerment, dignity, and belonging. These representations serve as a reminder that the "ordinary things" in urban contexts, such as light, roads, and digital communication, are still profound symbols of progress for rural Indigenous communities although they have only recently gained such access.

While their perception of technology can be empowering, the participants' stories also highlighted the exhausting nature of technology, particularly for mothers who managed their children's online learning during and after the pandemic. For instance, Respondent 3 used Youtube to help her children with English lessons, but she expressed frustration with slow internet and frequent buffering which caused stress and fatigue. Her experience reflects the gendered dimensions of digital labour, where rural women bear the emotional and logistical burdens of facilitating children's learning (Angit & Jarvis, 2024; Zainol & Karim, 2024).

Though technology enabled participation in education, it exposed inequalities in infrastructure and digital skills, amplifying the daily struggles of caregiving in digitally poor environments, such as climbing hills to access better signals. This underscores the need for gender-

sensitive digital inclusion strategies that recognise women's central role in sustaining household learning.

Overall, the narratives reveal a persistent gap between Malaysia's policy aspirations, which are embodied in frameworks such as the Malaysia Education Blueprint 2013-2025 and the SDG Roadmap Phase II (2021-2025), and the lived realities of Orang Asli communities. As mentioned prior, participants are situated in digitally poor environments where connectivity is considerably slow compared to urban places. Their stories illustrate that connectivity functions as an education lifeline which is essential for learning, access to information, and maintaining social connection (Sawalludin et al., 2020; UNICEF Malaysia, 2023). A digital divide still remains between rural and urban areas. While national policies champion "leaving no one behind", rural Indigenous learners continue to face digital exclusion due to weak infrastructure, limited devices, and culturally disconnected curricula (Abd Karim et., 2021). The result leads to potential young talents leaving early education to work in order to sustain themselves. Bridging this gap requires a shift from top-down implementation to community-driven, co-designed digital strategies that reflect local contexts and identities. With that said, these approaches would not only advance SDG 4 (Quality Education) and SDG 9 (Industry, Innovation, and Infrastructure) but also contribute to SDG 5 (Gender Equality) and SDG 10 (Reduced Inequalities) by empowering communities to shape their own educational futures.

To advance digital inclusion and equitable education among Orang Asli communities, this study recommends a multi-level approach. Starting from the structural level, investment in reliable, fast internet connectivity, and rural infrastructure are crucial and essential to closing the gap in terms of digital access between Indigenous and urban groups. However, internet connectivity and infrastructure alone

do not guarantee meaningful digital engagement. Investments in affordable devices, digital literacy, and technical support systems are still needed as well as long-term funding models and local maintenance capacity in order to maintain infrastructure.

Scaling down to the education sector, integrating Orang Asli oral traditions and knowledge into the curriculum can make digital learning culturally relevant and engaging. Teachers should receive training in culturally responsive and digital pedagogy, and they should also be supported with incentives for long-term service in rural areas. While the intention is to better support Orang Asli students, the additional training requirements may be perceived as more burdensome and stressful in a previously resource-constrained environment. As such, incentives aimed at encouraging long-term service in rural areas should be complemented with a professional and psychosocial support system inclusive of mentoring, career progression pathways, and adequate living conditions. Just financial incentives alone are unlikely to ensure sustained teacher retention (Arthur & Bradley, 2023).

Community participation is equally critical where programs should be co-designed with Orang Asli members to ensure local ownership and sustainability. However, the participatory process must proceed with careful precaution to avoid uneven representation within communities, particularly the marginalisation of women and youths. Additionally, too much participation and low execution can also be a problem. Repeated consultations without tangible outcomes may lead to participation fatigue and distrust. To prevent such risk, transparent decision-making processes and visible benefits are essential for sustaining community engagement.

It is important that all future interventions must adopt a gender-responsive lens. In the absence of targeted measures, digital inclusion initiatives may reproduce existing gender inequalities. Besides that, scaling up successful local initiatives will require constant effort, commitment, flexibility, and continuous evaluation to ensure that interventions remain responsive to Indigenous realities rather than imposing one-size-fits-all solutions.

The photovoice method exemplified co-design principles, allowing Orang Asli participants to define what technology means to them and how it shapes their learning experiences. This participatory lens aligns with recent scholarship on Indigenous research methodologies, which emphasise collaboration, mutual respect, and community ownership of knowledge rather than imposing external solutions. This ensures that interventions are not only effective but also culturally meaningful. Addressing economic constraints through device subsidies and flexible learning schedules will also help learners balance education with daily responsibilities. Finally, empowering women and fostering partnerships across government, NGOs, and private sectors can sustain inclusive progress in line with national SDG commitments.

LIMITATIONS

The present study's findings should be interpreted with caution due to several limitations. First under the methodology, there was a reliance on a single focus group discussion and a photovoice exercise involving only a small, self-selected sample of Orang Asli women and children. During data collection, many women and young children struggled to understand the discussion questions and the instructions for taking photographs, likely due to language and cultural barriers. This resulted in uncertainty and hesitancy in their responses, introducing personal bias in the selection of images and the narratives attached to them. Future research directions would benefit from including men

and older children to obtain a broader range of perspectives. For better delivery, employing a community liaison who is fluent in both the local language and English could make instructions clearer and reduce misunderstandings. Additionally, as this is only a single point data collection. Having a longitudinal design in the future would allow better assessments on how attitudes and practices evolve as community conditions change. Finally, relying solely on FGD and photovoice limits the ability to triangulate findings. Instead, incorporating additional methods would better capture the rich historical and cultural context of the Indigenous people.

CONCLUSION

This study shows that digital inclusion for the Orang Asli is not just about internet access but about social connection, dignity, and empowerment. Despite facing poor infrastructure and economic difficulties, the community demonstrated resilience by using technology creatively to learn and stay connected. The findings highlighted the need for redesigning policies by co-designing digital education strategies with Orang Asli communities, investing in rural infrastructure, and integrating Indigenous knowledge into learning. When these efforts are realised, Malaysia can truly achieve inclusive and equitable education in line with the SDG 2030 Agenda.

STATEMENTS AND DECLARATIONS

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This study examines how digital inclusion impacts quality education among the Orang Asli communities in Selangor. Although national policies such as the Malaysia Education Blueprint 2013-2025 and other plans aim to resolve the digital gap among the rural communities, many rural Indigenous learners continue to experience limited internet connectivity, lack of devices, and inadequate support. Using the photovoice method grounded in participatory lens between researchers and the Orang Asli communities, the research captures the lived experiences of the Orang Asli households as they navigate online learning and digital poverty. According to findings, there is a struggle in internet access as its instability often disrupts learning and deepens inequality causing students to leave education early and pursue work in order to sustain themselves financially. At the same time, their narratives also reveal how spaces like town halls and simple tools such as books, light, and roads contribute to empower connection and creativity in learning. Overall, the study highlights that digital inclusion for the Orang Asli communities is not just mere technology but rather creating conditions that support their learning, culture, and well-being in a digital world.

About the Author

Chung Jia Yiing is a postgraduate student currently studying at the University of Nottingham Malaysia specialising in community-based social research and participatory methodologies. Her work focuses on digital inclusion and education particularly among Orang Asli communities in Selangor.

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This programme empowers researchers under 35 to conduct qualitative research on pressing SDG-related issues in Malaysia. The resulting papers explore challenges affecting left-behind communities, directly supporting APPGM-SDG's grounded, evidence-based research agenda. The grant is offered and managed by APPGM-SDG's policy think tank, MySDG Centre for Social Inclusion.



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