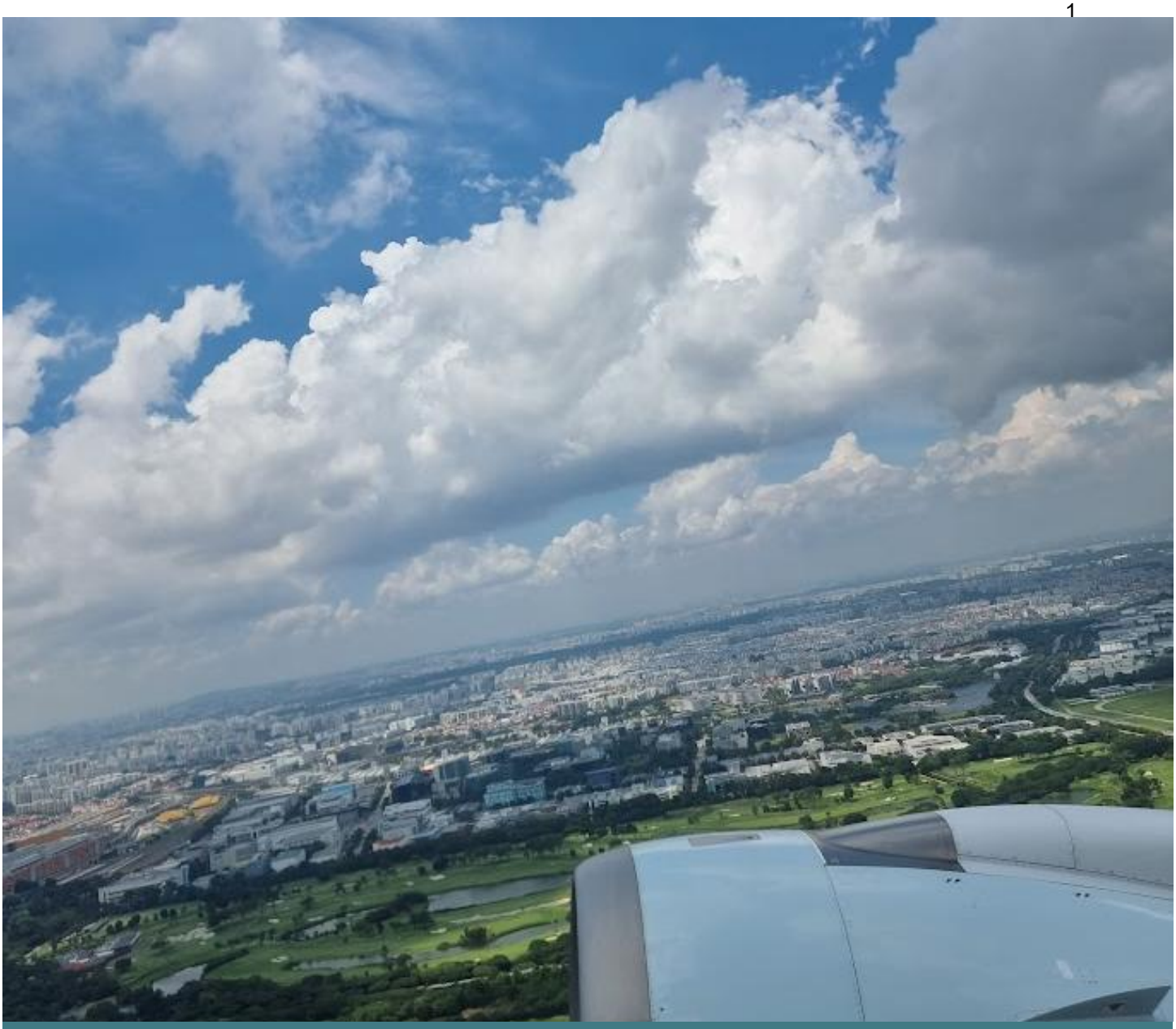

ReRoot Futures

A Biometric Pathway to Learning and Identity Across Borders

Group Members: Khor Kai Xiang , Ong Ghim Hwee Claire, Xu Meng, Xu Jiexia

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EXECUTIVE SUMMARY

In an unsettled world grappling with rising displacement due to geopolitical conflicts and climate disaster, millions of refugees and internally displaced people (IDP) lack access to quality education (Save the Children, 2020) and verifiable legal identity (United Nations, 2024).

Our project, **ReRoot Futures: A biometric pathway to learning and identity across borders,** directly responds to this call. It offers an innovative and scalable solution that redefines how refugees can reclaim their identity and educational journey. Our approach integrates a biometric-based digital identity – the "ReRoot ID" – with secure, portable digital wallet, empowering displaced learners with ownership over their identity, education records, and access to essential services. This solution comprises two interconnected pillars:

(1) **ReRoot ID – A biometric-based digital identity:** Adapted from secure national identity systems around the world (DiploFoundation, 2024), the ReRoot ID provides displaced individuals with a portable, user-owned and non-state-tied digital identity. Using biometric verification (eg: fingerprint or iris), this identity is securely stored and encrypted, enabling access to aid, services and future opportunities, regardless of formal documentation status or host country recognition.

(2) **ReRoot Wallet – A secure, portable digital wallet:** Paired with the ReRoot ID, the ReRoot Wallet functions as a secure repository for education credentials, aid disbursement, and skill-based micro-certifications.

Together, these components form a holistic digital infrastructure designed to empower displaced populations with dignity and long-term mobility- anchored in both identity and learning continuity.

THE TEAM

Khor Kai Xiang holds a Bachelor's degree in Electrical Engineering and a Master's degree in Instructional Design and Technology from Nanyang Technological University (NTU). He currently works at NEC Asia Pacific, supporting biometric system deployments at Singapore's immigration checkpoints—an experience that inspired him to apply technology for broader social impact through education. Merging technical expertise with instructional design, he has developed interactive, gamified learning modules on sustainability for adult learners with limited prior knowledge. He also serves as an Ambassador for the Singapore Leaders Network, contributing to regional dialogues on leadership and innovation. His interdisciplinary background fuels his commitment to inclusive, adaptive education that drives social change.

Khor Kai Xiang
(Singapore)

Claire Ong holds a Master of Arts in Instructional Design and Technology from Nanyang Technological University (NTU) and a Bachelor of Science in Data Science and Analytics from the National University of Singapore. With over seven years of experience as an educator and tutor, she specializes in learner-centered, technology-enhanced instruction for secondary Mathematics and Science. Her background in data analytics and educational technology enables her to design cognitively optimized, engaging learning experiences. Claire previously interned as a Data Analyst at Singapore's Health Promotion Board, building Power BI dashboards and supporting data-driven public health efforts. Passionate about education equity and innovation, she applies her multidisciplinary expertise to create inclusive, adaptive solutions that support every learner's path to success.

Ong Ghim Hwee Claire
(Singapore)

XuMeng is currently pursuing a Master's degree in Instructional Design and Technology at Nanyang Technological University (NTU), Singapore. She holds a Bachelor's degree in Network Engineering, which laid the foundation for her technical expertise. After graduating, she began her career as a network engineer but soon discovered a deeper passion for education. She transitioned into teaching, first in the K–12 sector and later as a lecturer at a private university. These roles deepened her understanding of learner challenges and sparked a commitment to improving educational practices. Her current research focuses on using emerging technologies—such as virtual reality and AI—to enhance learning and promote equity. With a background bridging engineering and pedagogy, she offers a unique, interdisciplinary perspective on designing inclusive, tech-driven solutions for underserved and displaced learners.

XuMeng
(China)

Xu Jiexia (Sue) holds a Master's degree in Instructional Design and Technology from Nanyang Technological University (NTU). Her academic background in literature and media studies shaped her expertise in storytelling and narrative construction. She began her career in digital media production and content operations at ByteDance Ltd., where she developed educational content for the "Ocean Engine University" platform and learning modules across industries. This work sparked her passion for education and commitment to making complex information engaging and accessible. Her current research focuses on integrating digital storytelling with modern learning technologies to enhance educational outcomes and foster cross-cultural understanding. Bridging creative media and educational design, she brings a unique, interdisciplinary approach to developing culturally inclusive, narrative-driven learning experiences.

Xu Jiexia
(China)

CHAPTER 1: INTRODUCTION AND BACKGROUND

In today's world, humanitarian crises are growing in both scale and complexity. As of 2024, over 117 million individuals worldwide have been forcibly displaced due to conflict, persecution, human rights violations, and climate-related disasters (UNHCR, 2024).

Among the displaced, two key groups stand out: internally displaced people (IDPs) and refugees. Though their circumstances differ, both face immense challenges in rebuilding their lives.

Internally displaced people (IDPs) are individuals or groups forced to flee or leave their homes or due to armed conflict, generalized violence, human rights violations or natural disasters – yet they remain within their country's borders (United Nations Office for the Coordination of Humanitarian Affairs, 1998).

Refugees, on the other hand, are individuals or groups who have crossed an international border to escape persecution, war, or violence. According to the 1951 United Nations Refugee Convention, a refugee is someone who, "owing to well-founded fear of being persecuted for reasons of race, religion, nationality, membership of a particular social group or political opinion, is outside the country of their nationality and is unable or unwilling to avail themselves of the protection of that country" (United Nations High Commissioner for Refugees, 1951). Refugees are protected under international law, specifically the 1951 Refugee Convention and its 1967 Protocol, which oblige host countries not to return them to danger (the principle of non-refoulement) and to ensure access to basic rights such as access to education, healthcare, and work (UNHCR, 1967).

Both groups face similar systemic barriers to rebuilding their lives, particularly in two critical areas: legal identity and education. Without these, reintegration into society remains out of reach. This report will focus on refugees—individuals who have crossed international borders due to conflict, persecution, or disaster.

In an ideal situation, refugees are equipped with secure, digital legal identities and have access to continuous, flexible education—especially skill-based training aligned with labour market needs. These tools would enable them to regain autonomy, access public services, find employment, and meaningfully contribute to their host communities.

However, the current reality falls short. Many refugees lose personal documents during displacement, and host countries often lack the infrastructure or political commitment to register them. This leads to legal invisibility, preventing access to education, healthcare, financial services, and formal employment. Their learning is also severely disrupted, with barriers such as language differences, overcrowded classrooms, and a shortage of vocational programs tailored to their needs.

Biometric identification presents a viable solution. By leveraging unique physical traits—such as facial features or iris patterns—refugees can receive secure, portable digital IDs that are independent of physical documents. These IDs enable fast and reliable identification across borders and institutions.

At the same time, ensuring learning continuity means providing displaced individuals with access to education despite instability. Through mobile learning hubs, digital platforms, and locally relevant vocational training, refugees can gain practical skills suited to their new environments—such as caregiving, food preparation, hairdressing, or basic technology services.

When refugees are equipped with legal identities and uninterrupted learning opportunities, they are better positioned to become economically self-sufficient. This shift from aid dependency to productivity not only improves individual well-being but also strengthens host communities, creating a mutually beneficial outcome.

CHAPTER 2: CORE CHALLENGES OF THE GLOBAL REFUGEE CRISIS

Analysis on latest developments

In today's volatile geopolitical climate, the global population of forcibly displaced people have surged to record-breaking levels. As end 2024, 123.2 million people — 1 in every 67 globally—were forcibly displaced (UNHCR, 2025). This figure (Figure 2.1) has nearly doubled in a decade, reflecting a complex crisis. Four key barriers —lack of legal identity, disrupted education, limited basic services, and declining mental health undermine sustainable reintegration and self-reliance.

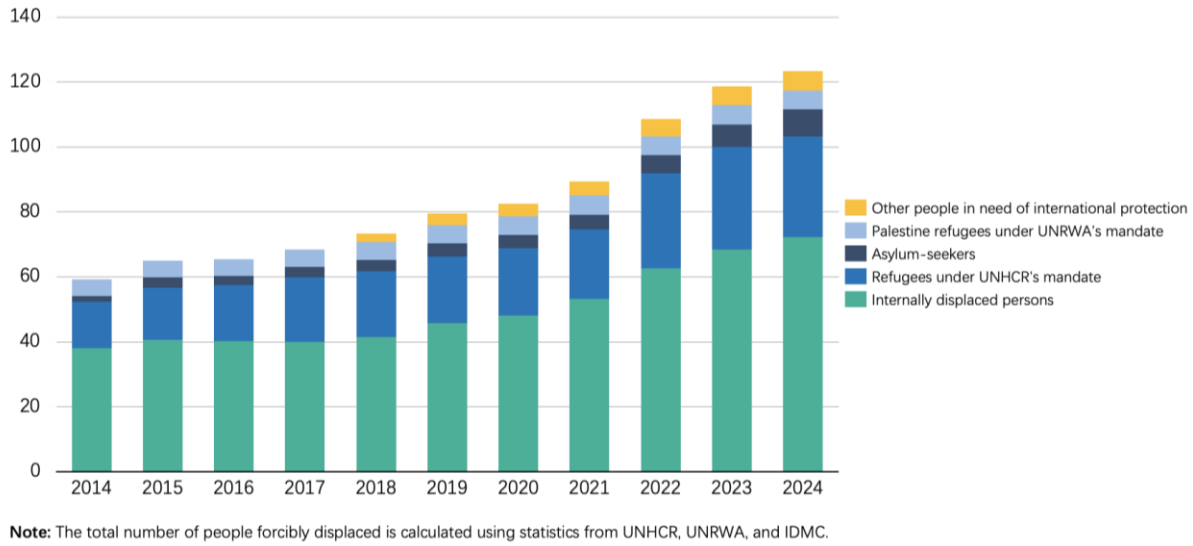

Figure 2.1: Global Forced Displacement Trends, 2014-2024

(Source: UNHCR, Global Trends: Forced Displacement in 2024)

Legal Identity Deficiency: The Exacerbation of Contemporary Statelessness Crisis

Lack of legal identity is a critical humanitarian crisis. Millions of displaced people are rendered invisible—not because they don't exist, but because they cannot prove they do. In conflict zones like Gaza, Syria, and Sudan, collapsed civil registries and repeated displacement have caused widespread loss of identity documents.

The ongoing turmoil in the Middle East illustrates the severity of this issue. In Gaza for example, nearly 1.9 million Palestinians (about 90% of the population) were displaced by early 2025 (Al-Monitor, 2025). While many families initially fled with essential documents, repeated relocations result in the loss or destruction of these documents. Each evacuation strips away a layer of legal recognition, leaving families without a single means to verify their existence. The erosion of identity in displacement can be understood through four distinct phases, each compounding the crisis (Table 2.1).

Phase	Key Characteristics	Impact on Legal Identity
Phase 1: Initial Displacement	1.9 million people forcibly displaced from their homes since Oct 2023. Most families fled with essential documents if possible.	Basic legal documents (IDs, family books) still held by majority.
Phase 2: Repeated Displacement Cycle	Many families were displaced 10+ times due to ongoing bombardment and relocation orders. Personal belongings and documents lost/damaged.	Progressive loss of ID documents during each forced move.
Phase 3: Collapse of Identity Systems	Civil registry offices and hospitals destroyed. Overwhelming breakdown of institutional recordkeeping.	Thousands unable to access services due to lack of documentation.
Phase 4: Intergenerational Impact	New-borns unable to be registered due to hospital collapse and administrative vacuum.	Risk of a new generation becoming stateless by default.

Table 2.1: Displacement process and impacts

As indicated in phase 3 and 4 above, the collapse of civil institutions, including registry offices and hospitals, also blocks access to basic services and prevents the registration of newborns, resulting in the risk of an entirely stateless generation. These identity gaps are not only legal but structural, affecting access to education, financial systems, healthcare, digital services, and even humanitarian aid.

In an increasingly digital world, absence of verifiable identity excludes refugees from almost every institutional system. The longer this gap persists, the deeper the marginalization becomes, perpetuating cycles of invisibility, dependency, and exclusion as illustrates in Figure 2.2.

Figure 2.2: Long-Term Implications of Loss of Legal Identity

Source: Adapted from Blitz (2016)

Educational Opportunity Disruption: The Loss of a Generation's Developmental Potential

Skills-based education is vital for refugees' long-term recovery and reintegration, yet it remains one of the most disrupted sectors. In Gaza, 95.4% of schools have been damaged or destroyed (Johnson, D., 2025). While children education often takes priority, the collapse of adult education and vocational training is an equally urgent but under-addressed challenge—one that critically impacts economic self-reliance and social integration.

Figure 2.3: Collapse of Skills Training Systems

Source: Tasli-Karabulut (2024)

This collapse stems from three core issues as shown in Figure 2.3: (1) **loss of skill verification**, where individuals cannot prove their abilities without formal credentials; (2) **skill mismatch**, as their expertise no longer aligns with evolving labour market demands; and (3) **skill obsolescence**, where time away from work leads to declining proficiency.

In Syria, for example, despite political openings for educational reform, deeper challenges persist. Roughly 90% of the population lives in poverty, with many still reliant on camps for basic needs. Returning adults find a drastically altered economy, where traditional industries have disappeared and no training systems exist for new sectors, blocking their path to meaningful reintegration.

Barriers to Basic Services: The Deepening of Systematic Exclusion

The third major barrier is systemic: limited access to basic services, largely due to the lack of verifiable identity documents and certified credentials. These challenges are worsened by today's resource-constrained context, restricting refugees' access to healthcare, education, legal aid, and employment as emphasized in Figure 2.2.

Although displacement has surged, UNHCR funding has remained flat since 2015 (UNHCR, 2025), widening the gap between demand and resources. Geographic restrictions also add strain—Syrian refugees, for instance, can only access healthcare in their registered cities, limiting emergency care (Karasapan, 2022). With relief systems overwhelmed and infrastructure stuck in crisis-response mode, long-term recovery remains out of reach.

This breakdown shows that refugee integration cannot rely on individual capacity-building alone. It requires systemic reconstruction—revamping institutions, resource allocation, and service delivery models to meet actual needs and enable sustainable reintegration.

Systematic Interconnection of Problems and the Urgency of Solutions

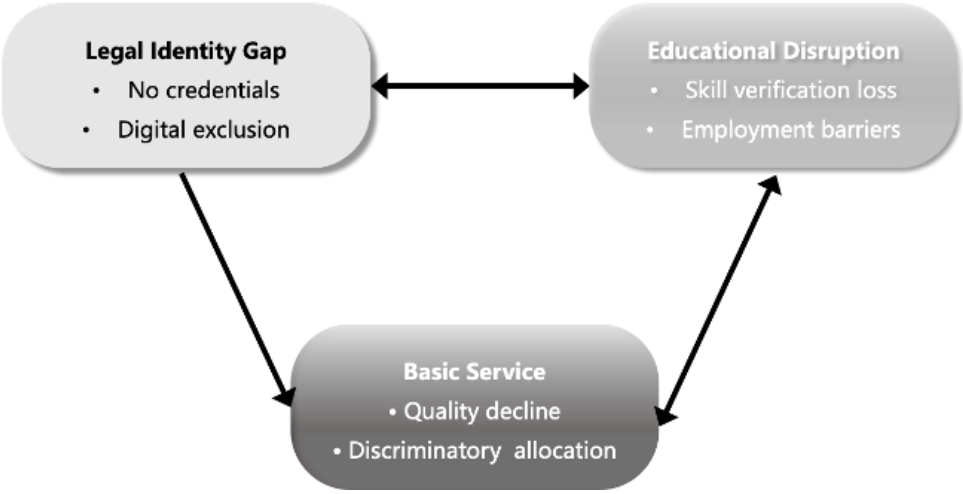

Figure 2.4: Core Challenges Interaction Framework

These core barriers as indicated in Figure 2.4 — legal identity, education disruption, access to services are deeply interconnected. A refugee without identity cannot access school or healthcare. A lack of education hinders job access, which in turn deepens reliance on humanitarian aid. These overlapping vulnerabilities create compounding disadvantages that demand integrated, scalable, and context-sensitive solutions.

While emergency responses remain essential, the global community must also focus on long-term integration. In countries like Malaysia, which hosts over 200,000 registered refugees (UNHCR Malaysia, 2025), displaced individuals face new challenges beyond survival—such as the need for digital identity, relevant vocational skills, and access to digital services. There is an urgent need to design adaptable, tech-enabled capacity-building programs that meet the evolving realities of settled refugees. These programs must not only restore lost systems but reimagine them to promote autonomy, dignity, and long-term inclusion.

CHAPTER 3: PROJECT OBJECTIVES AND RESEARCH QUESTION

As demonstrated in the preceding chapters, the global refugee crisis is not defined solely by displacement, but by the loss of autonomy that follows. Refugees face interlinked barriers that compound over time: the absence of legal identity, the disruption of learning pathways, and exclusion from formal systems. These challenges are not temporary but they persist long after emergency aid is delivered, trapping refugees in cycles of invisibility, dependency, and marginalization.

Despite growing global attention, many existing interventions remain fragmented and short-term in nature. While humanitarian agencies and host governments address immediate survival needs, few initiatives are designed to restore refugees' long-term agency, continuity, or ownership over their lives. Legal identity systems are often externally controlled, while educational efforts frequently lack recognition, relevance, or the means to travel with the learners.

As Dryden-Peterson (2024) argues, the top-down approach fails to reflect the lived realities and aspirations of refugee communities. Refugee are not passive recipients of assistance. They are learners, workers and parents who actively seek to reclaim control over their futures. This insight forms the central inquiry of our project:

How can integrated digital system restore refugee agency over legal identity and education, enabling continuity, recognition, and future mobility?

Current biometric based systems such as those implemented by the United Nations High Commissioner for Refugees (UNHCR) in Jordan (REACH Alliance, 2017) have demonstrated potential for aid distribution. However, refugees fail to take control over their identity or continuity in education. This leaves a critical gap between access and agency.

To address this, we propose **ReRoot Futures** : *An integrated solution that combines biometric-based digital identity, a portable digital wallet, and modular, multilingual learning tools.*

This system would allow refugees to securely manage their identity, store verifiable credentials, and access skill-based education aligned with local labour markets regardless of their geographic location.

ReRoot Futures is not just about restoring access but it is about restoring dignity, autonomy, and the capacity to shape one's own path. By bridging the divide between identity, learning, and opportunity, this project reimagines refugee support as a platform for sustainable reintegration and long-term resilience.

CHAPTER 4: SOLUTION OVERVIEW

In response to the fragmented and top-down approaches that currently define refugee identity and education systems, ReRoot Futures introduces a unified, offline-capable digital ecosystem grounded in refugee autonomy, equity, and continuity. The solution is built around two pillars: **ReRoot ID and ReRoot Wallet** as shown in Figure 4.1.

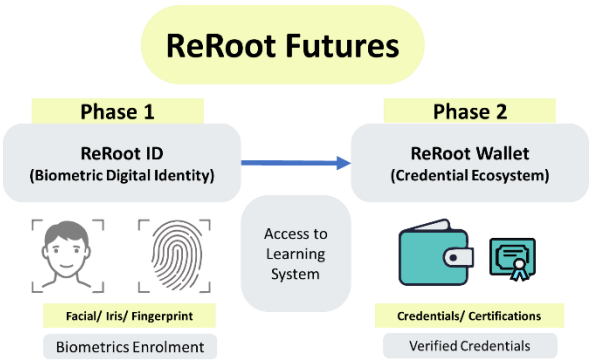

Figure 4.1: Phase 1 and Phase 2 of Implementation

This ecosystem is driven by a core belief that legal identity, access to learning, and opportunity must be inseparable. When refugees can securely prove who they are and demonstrate what they know, they regain visibility in the system and control over their future.

The terminal objective of this solution is clear:

Refugees will be able to independently use a biometric-based digital identity and portable learning wallet to access services, continue education, and present verifiable credentials across borders

Reroot ID – Secure Identity, Anywhere

ReRoot ID addresses the foundational challenge of legal identity. It provides refugees with a portable, self-owned biometric identity that is not dependent on state-issued documentation. Using fingerprint and/or facial or iris recognition, refugees verify their identity through offline-secure processes supported by local servers and biometric hardware. These can synchronize to cloud-based systems when internet connectivity becomes available.

This decentralized approach enhances data sovereignty and minimizes cybersecurity risks. Data is encrypted and stored locally on solar-powered drives, built for off-grid environments. Refugees retain full control of their records through a dual-authentication system that combines both biometric verification with traditional login (username and password). This ensures access remains secure even in low-connectivity settings.

Once authenticated, users can access ReRoot Wallet which will house learning platform and also in future phases, expand to include healthcare, financial services, and job application support.

Reroot Wallet – Learning that moves with you

ReRoot Wallet is a secure, portable learning and credential platform that empowers refugees to pursue lifelong learning and store achievements that are tamper-proof and shareable with employers, institutions, or aid agencies.

This digital wallet houses micro-credentials, certificates, language training achievements, and professional development progress as shown in Figure 4.2.

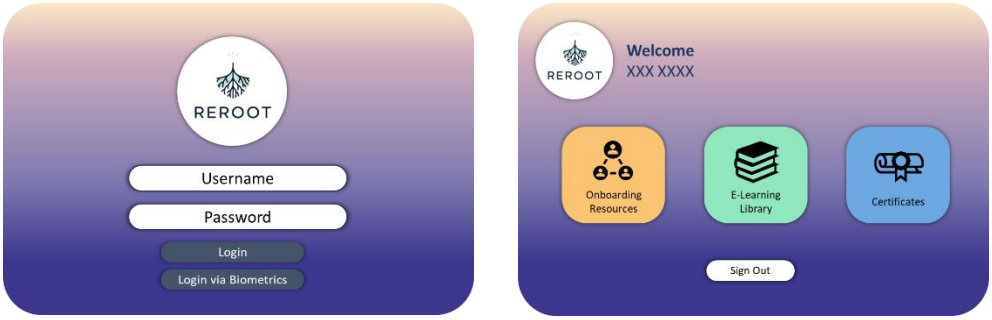

Figure 4.2: Mock-up UI of the digital wallet application

The learning content is delivered through multilingual, asynchronous modules, designed for offline-first use. Refugees can progress at their own pace, starting with onboarding topics like biometric identity usage, host-country languages, digital skills, and cultural orientation in host countries. As the platform sales, additional content will include: STEM modules for youth, advanced vocational skills, financial literacy, entrepreneurship, etc.

To support user onboarding and navigation, each learning hub will include a facilitated support booth. Trained staff will assist with registration, navigation, and learning pathways, boosting learners' confidence and inclusion. Whilst not core to the initial pilot, ReRoot Wallet can be adapted to include learning-linked incentives such as transport vouchers or meal credits which can be redeemable at local partner vendors. This can encourage consistent engagement in later phases or through local partnerships.

Solution Deployment Strategy

Deployment begins in community library-based learning hubs. Each site will be equipped with 20 shared tablets, charging stations, signages in local languages and facilitators providing real-time support.

Refugees will begin their learning journey by enrolling and registering their biometric profile. Once logged in, they complete an orientation module and choose from a range of self-paces courses in either onboarding modules which will include language training, basic healthcare, digital and financial literacy or industry-specific skills like first aid courses or hairdressing. This can be illustrated in Figure 4.3 below.

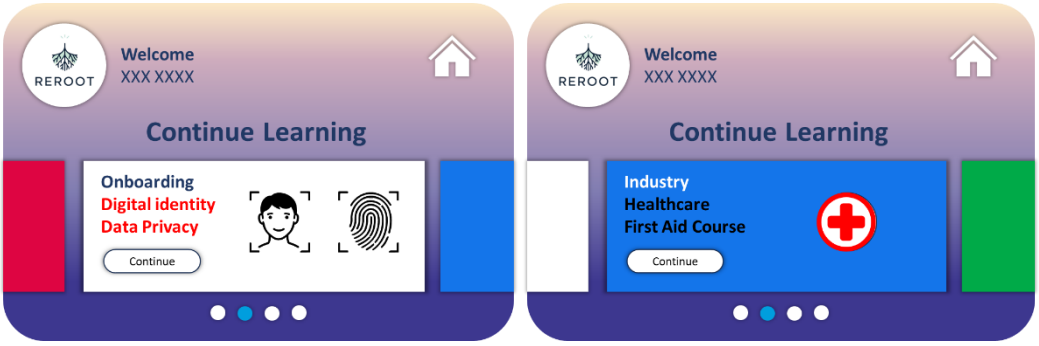

Figure 4.3: Mock-up UI of learning courses available

Progress is then saved in the ReRoot Wallet, which can be accessed from any connected device. All credentials are verifiable, portable, and synchronized securely when internet is available.

To expand beyond hubs, the solution includes an Android-based mobile application. Refugees can login with their credentials on personal smartphones, maintaining access during relocation or camp transitions. Offline functionality ensures learning continues regardless of connectivity, with automatic synchronization upon reconnection. This system architecture enables it to scale across borders and adapt to varied refugee contexts. It is intentionally built for resilience in low-resource, unstable environments.

At its core, ReRoot Futures redefine refugee support. It does not treat refugees as beneficiaries of charity but as agents of their own change. By restoring the ability to prove identity, pursue learning, and access opportunity, it transforms humanitarian assistance into a platform of empowerment.

This dual-pillar ecosystem offers more than tools. It offers digital dignity, mobility and a chance to grow despite instability. It is scalable, adaptable, and grounded in the principle that no one should be invisible simply because they were forced to flee.

CHAPTER 5: TRAINING PROGRAM DESIGN

Dryden-Peterson (2024) highlights a critical gap in refugee education**: Access to schooling does not guarantee meaningful learning**, and learning does not always translate into opportunities. This fames the three major challenges addressed in this chapter:

(1) **Access without learning** — Refugees may be physically present in classrooms but often lack adequate materials, trained educators, or language support.

(2) **Learning without recognition** — Skills acquired through informal or alternative education are rarely validated in formal systems.

(3) **Misaligned structures**— Host country education systems are typically not designed to reflect refugee realities or certify their learning.

To tackle these fundamental challenges, ReRoot Futures grounds its training program in sound educational theory, particular cognitive load theory and the Four-Component Instructional Design (4C/ID) model.

Cognitive load theory, as proposed by Sweller et al. (1998), distinguishes between intrinsic, extraneous, and germane cognitive load. In the refugee context, it provides a framework for designing content that reduces mental overload, improving comprehension and retention especially in low-resource contexts.

The 4C/ID model, developed by Van Merriënboer and Kirschner (2018), provides a structured framework for developing complex skills through authentic, whole-task experiences that mirror the complexities of real-world practice. This model operationalizes the theoretical principles by supporting systematic learning processes through carefully structured authentic task experiences and embedded certification mechanisms. Together, these theories underpin a training model that is both pedagogically rigorous and contextually adaptable.

Three-Stage Journey from Displacement to Integration

A. Enrolment and Onboarding Phase: Building Digital Confidence

The onboarding phase is designed to transform the often-intimidating process of biometric registration and digital platform navigation into a welcoming and low-stress experience. Upon entering learning hubs, refugees are guided by multilingual facilitators trained in trauma-informed practice.

Cognitive Load Theory will ensure that delivery of content is digestible, helping refugees manage complex tasks like onboarding and navigating the platform. Guided by the 4C/ID model (Fig. 5.1), the onboarding process will include authentic, whole-task learning, enabling refugees to create a secure digital identity, navigate their learning dashboard and select relevant education pathways.

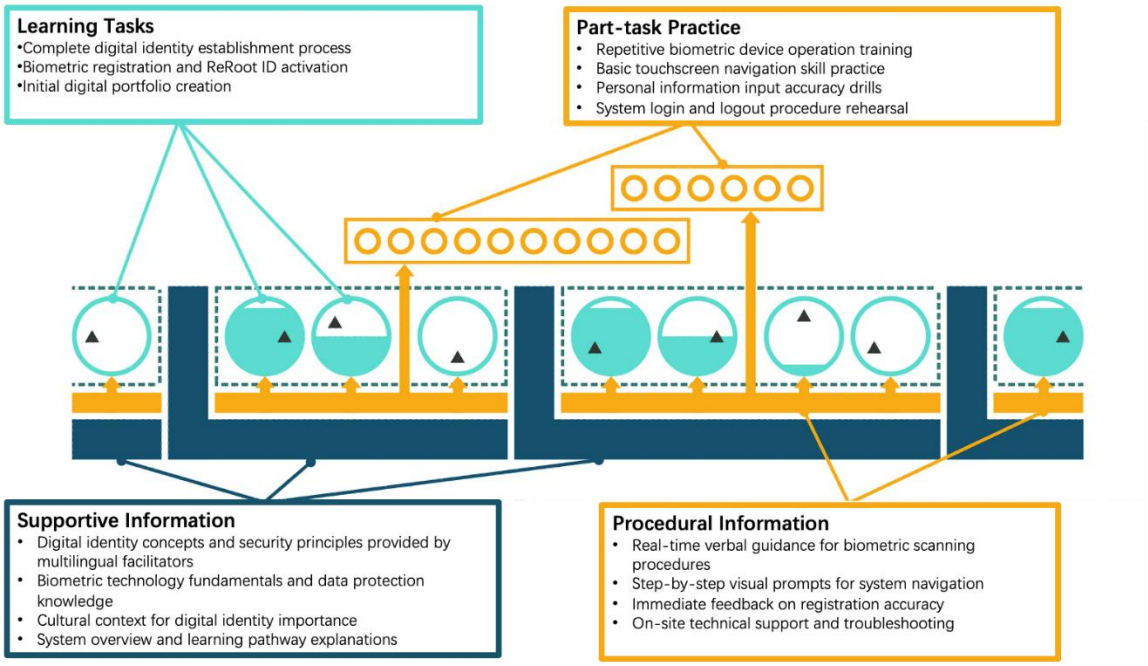

Figure 5.1: 4C/ID – Enrolment and Onboarding Phase

To support this, visual aids, native language instructions, and self-paced modules are built in to reduce cognitive strain. The biometric registration process itself is broken into intuitive, guided steps, reinforcing user autonomy and platform trust.

B. Onboarding and Industry Specific Courses: Asynchronous Digital Learning Phase

This phase departs from traditional, lecture-heavy models. Instead, refugees engage in short, scenario-based modules that mirror daily life. This will cover language, digital skills, basic health and cultural orientation. To minimize mental fatigue, video lessons are capped at 15–20 minutes. Learners can pause, replay, or adjust speed. Subtitle support and native-language comparison will also be added to help reduce extraneous cognitive load.

The 4C/ID model in Figure 4.2 will structures learning around authentic, whole-task engagement. Language modules will emphasize greetings and functional conversations. Refugees will gain practical competencies in emergency response and personal safety through foundational health modules, develop social integration skills via culturally relevant content, and build digital literacy to navigate technology with confidence.

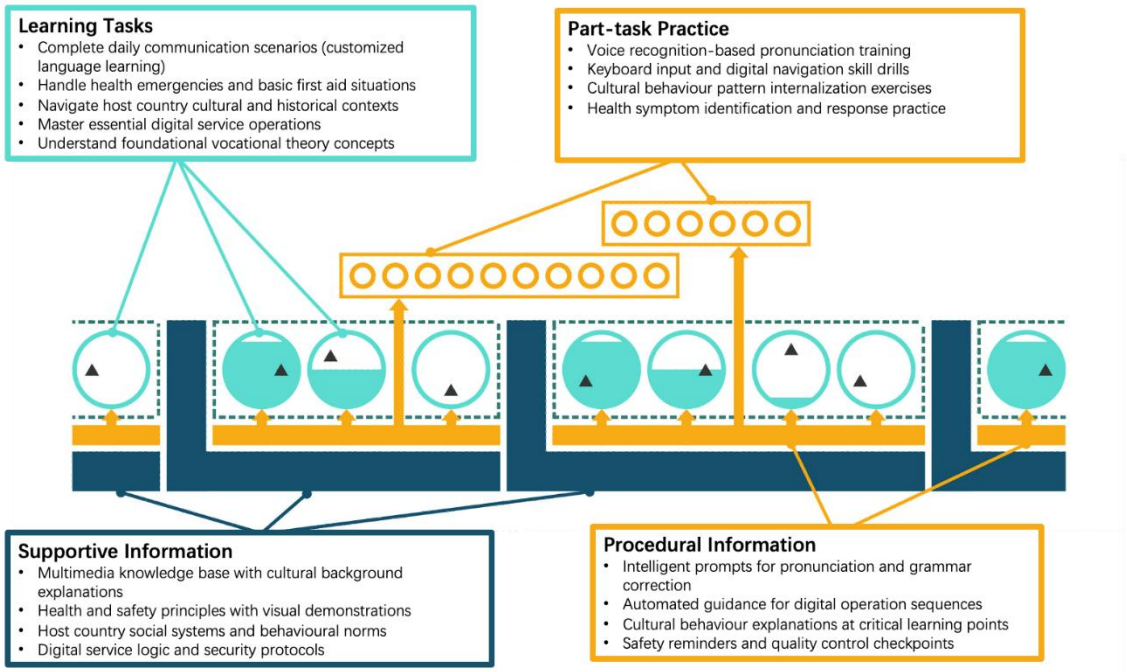

Figure 5.2: 4C/ID - Digital Learning Phase

To further enhance learning, intelligent just-in-time support system will provide automated prompts at key moments. This will offer pronunciation feedback for language modules, task-specific guidance, and culturally relevant explanations for cultural modules. Integrated tools such as voice recognition,

simulated environments, and scenario-based dialogue practice can also be applied to help learners build confidence and fluency, transforming new knowledge into usable skills.

C. Face-to-Face Professional Development Phase: Achieving Economic Independence

In the final phase, learners progress from foundational knowledge to job readiness through immersive, in-person vocational training. Human interaction plays a pivotal role. Instructors and mentors will model professional conduct, deliver real-time feedback, and reinforce both workplace norms and cultural expectations. Immediate feedback and tailored guidance help learners stay within their optimal learning zone, making complex skill acquisition more manageable.

Instruction is grounded in the demonstration–practice–feedback cycle, shaped by both cognitive load principles, which ensures that vocational skills are developed progressively and effectively within a supportive learning environment, and the 4C/ID model (see Fig. 5.3) will anchor instruction in the completion of authentic work tasks across various sectors like hairdressing, culinary arts or basic nursing. Each professional track involves mastering the full workflow—from customer interaction and service execution to quality assurance and final delivery—fostering comprehensive, job-specific competencies and adaptability.

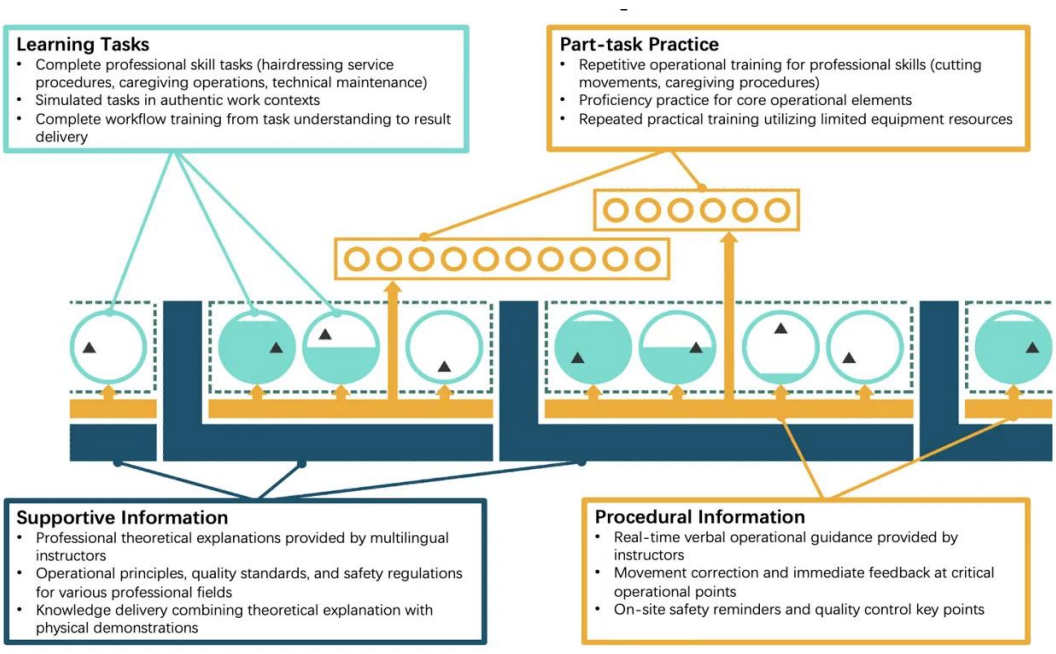

Figure 5.3: 4C/ID - Professional Development Phase

Skills that require automation such as safety procedures or routine operations, are practiced intensively until learners can perform them with fluency and confidence. This structured approach ensures that graduates not only meet the technical demands of the workplace but are also equipped with the adaptability and independence necessary for long-term economic self-sufficiency.

Supplementary Design for Youth Education Support: Designing for Next Generation

While adult learners build skills for self-reliance, displaced youth face unique challenges. ReRoot Futures will expand to support refugee youth aged 12-18 by incorporate Science, Technology, Engineering, and Mathematics (STEM) content to reconnect with formal education systems. Through the same digital identity system, youth will also be able to track their academic progress and build comprehensive digital learning portfolios. These records serve as portable, verifiable credentials that support continued education and future employment, safeguarding against the frequent loss of educational documentation caused by repeated displacement and transitions.

To address the emotional and social challenges, the system will include a Conflict-Sensitive Curriculum Toolkit embedding peace education, non-violent communication, online therapy access for trauma recovery and empathy-building and social cohesion tools. These resources ensure that emotional healing and cognitive growth go hand in hand, creating a generation better prepared for personal and communal rebuilding.

ReRoot Futures reimagines training not as charity, but as a return to agency, dignity and purpose. Grounded in cognitive science and responsive to lived realities, this design turns fractured learning journeys into structured pathways, empowering refugees to reclaim their futures.

CHAPTER 6: IMPLEMENTATION STRATEGY

To ensure ReRoot Futures is not only a visionary concept but a scalable, real-world solution, this chapter outlines a phased, stakeholder-driven implementation strategy grounded in practical deployment, community empowerment, and long-term sustainability. The initial focus will be on scalable deployment in Malaysia, with future adaptability across other refugee-hosting contexts.

Key Stakeholders and Partnerships

The successful implementation of ReRoot Futures hinges on coordinated collaboration between international organizations, national governments, local NGOs and community facilitators. The primary stakeholders include the UNHCR (United Nations High Commissioner for Refugees), Save the Children and similar NGOs, Ministries of Education and Interior Affairs of host countries, and technology partners. These actors collectively form the foundation for both deployment and validation of ReRoot across regions. Table 6.1 shows the purpose of each key stakeholder.

Key Stakeholders	**Purpose**
UNHCR	Critical for integrating ReRoot into existing refugee intake and support operations.
Save the Children (+ Similar NGOs)	Trusted access points to communities, providing essential educational outreach and field personnel.
Ministries of Education and Interior Affairs (Host Countries)	Essential for recognizing ReRoot credentials and supporting national adoption.
Technology Partners	For biometric hardware, software maintenance, and app development.

Table 6.1: Key stakeholders and their purposes

Pilot Rollout Plan

The pilot rollout will geographically target host countries with substantial refugees or IDP populations and cooperative humanitarian infrastructures. As of May 2025, there are 200,260 refugees and asylum-seekers registered with UNHCR in Malaysia (UNHCR, n.d.). There are 59,250 children below the age of 18 (UNHCR, n.d.).

Malaysia has been selected base on the strong refugee presence, active partnership with UNHCR (e.g. Refugee Protection and Registration, Self-Reliance Initiatives) (UNHCR, n.d.) and NGOs (e.g. Mercy Malaysia - healthcare outreach for refugee groups), and a relatively stable political environment (Morgan Stanley Investment Management, 2024). These factors make it operationally feasible for biometric enrolment and digital infrastructure deployment.

Area	**Key Collaborators**	**Activities**
Protection	Government, UNHCR	Refugee registrations, Legal status, Detention prevention
Livelihoods	Tzu Chi Foundation, Malaysian Relief Agency (MRA)	Cash aid and health subsidies
Legal and Education	Malaysian Social Research Institute (MSRI)	Legal aid, policy advocacy, skill development
Health	Mercy Malaysia, Malaysia Relief Agency, Malaysian Red Crescent Society	Medical clinics, pandemic response, family reunification
Participation	Refugee Advisory Board	Refugee representation, shelter

Table 6.2: Existing collaborators in Malaysia

The pilot phase objectives are as follows:

(1) Validate biometric registration and the ReRoot ID creation

(2) Launch the ReRoot Wallet with foundational learning modules

(3) Monitor uptake, technical reliability and user satisfaction

(4) Train facilitators and onboard learners.

Deployment Infrastructure and Logistics

ReRoot Futures' infrastructure has four main components:

(1) **ReRoot ID Onboarding:** Mobile enrolment booths will be equipped with fingerprint and/or iris scanners, tablets, and solar-powered UPS backups. Refugees are onboarded with local facilitator support. Identity data will be stored locally and securely synchronized to cloud systems when connectivity is available. Privacy protocols are strictly followed.

(2) **ReRoot Wallet Implementation:** Refugees will gain access curated micro-learning modules mapped to UNESCO digital skills frameworks (as part of our onboarding) and localized (industry) needs (e.g. first aid for health care industry). All completions generate verifiable credentials viewable via a learner's ReRoot Wallet. This will be accessible via the learning facilities tablets or their own mobile devices.

(3) **Learning Facilities**: Learning hubs will include 20 tablets, power access and safe seating. The on-site facilitators will guide learners through platform orientation, digital skills development and course progression. Physical signage and instruction manuals in multiple languages will be provided to address diverse language needs.

(4) **Staffing Plan:** There are two phases to staffing. Phase 1 involves training NGO staff via a "train-the-trainer" model. Phase 2 would include direct employment of local facilitators and digital literacy coaches from host communities or displaced populations. Phase 2's long term goal is to provide income opportunities for refugees through roles as peer educators and digital mentors. This will also contribute to the cohesion and comfort of refugees having a fellow refugee as their facilitator.

Suggested Pilot Locations

Malaysia mainly hosts refugees in Kuala Lumpur, Selangor, Penang and Johor Bahru (Nah, A.M., 2018) as shown in table 6.3. For the pilot run, 3-5 learning hubs will be set up at each site.

Suggested Locations	**Reason**
Kuala Lumpur	Densely populated refugee community (Rohingya, Pakistani)
Penang (George Town)	Myanmar refugee population, active civil society
Johor Bahru	Proximity to transit and resettlement areas
Selangor	Strong UNHCR/NGO presence, so logistics are accessible

Table 6.3: Suggested pilot locations and reasons

Testing across these diverse regions will evaluate system performance in urban/rural areas, high/low digital literacy environments, and varied ethnic groups. The scale allows effective deployment with 20 tablets per hub and 1 facilitator on site. Facilitator training and supervision will be led by a central pilot team from the technology and education departments, enabling close monitoring and rapid iteration.

Collaborations with existing spaces like UNHCR Education Unit, MSRI, and Tzu Chi Learning Centres (Tzu Chi Malaysia, n.d.) (Refugee Malaysia, 2022) in Malaysia can help reduce costs and set up time. Starting with 3-5 hubs allows the leverage of existing spaces and networks which reduce setup time and costs. The small pilot allows data collection to improve the model, as well as build evidence and trust with local authorities and UNHCR for scale up.

Each hub can serve 100 to 200 learners per month in rotating sessions. With 5 hubs, this will result in about 500-1000 pilot users. This will be sufficient for us to collect insights, refine the curriculum, and assess impact before scaling.

Distribution and Outreach

ReRoot Futures will leverage existing humanitarian aid networks for maximum visibility and participation. Distribution strategies include community workshops to introduce ReRoot features and benefits, facilitator-led orientations in local languages, printed and digital outreach materials with visuals and icons to guide sign-ups and usage, NGO-run mobile units to reach remote settlements or informal camps. As Malaysia is not a signatory to the 1951 Refugee Convention, all outreach will be framed around education and digital empowerment through NGO-led community spaces. Data privacy, neutrality and non-state-controlled identities will also be emphasized to build trust. Whilst not central to the deployment, learning-linked rewards such as transportation tokens or meal coupons could be considered through in-kind partnerships with humanitarian organizations to improve uptake where culturally appropriate.

Monitoring and Scaling Strategy

Data dashboards will be used to track enrolment, module completion and credential issuance. Monthly facilitator reports on learner progress and platform challenges will be feedbacked from users and partners. To ensure scalability and long-term sustainability, the design of the technology and implementation has been considered. Open-source architecture will be implemented in the software to allow integration by national agencies. The modular design of the system allows for region-specific adaptations.

Employment and Community Integration

ReRoot Futures support refugee livelihoods through its implementation model. Facilitator roles offered in phase 2 provide employment opportunities for refugees and locals. Micro-certification opportunities from the Wallet unlock pathways for teaching assistant, tech maintenance and peer trainer roles. ReRoot credentials will also be tailored for use in job applications, vocational programs and formal education systems to ensure support in reintegration to society for refugees.

Logic Model

To provide a cohesive overview of how ReRoot Futures translates its mission into measurable impact, the following logic model (Figures 6.1, 6.2) outlines the alignment between identified challenges, strategic investments, planned activities and intended outcomes. It highlights the critical role of cross-

sector stakeholders - including NGOs, instructional designers and technology developers - in delivering verifiable learning and identity solutions to displaced learners. This framework ensures that implementation remains both outcome-driven and adaptive across diverse humanitarian contexts, guiding ReRoot Futures' pilot and future scale-up efforts.

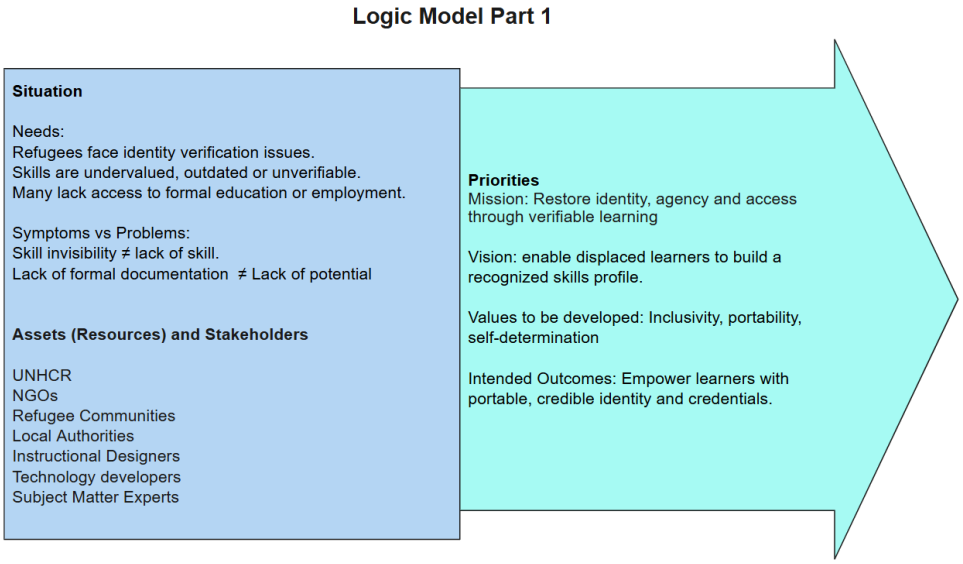

Figure 6.1: Logic Model Part 1

Inputs	Outputs		Outcomes - Impact		
	Activities	Participation	Short	Mid	Long
Human Resources: ReRoot Facilitators, NGO and UNHCR staff, Instructional designers, Refugee community ambassadors, Evaluation team **Technology Resources**: Biometric kits, Tablets, solar-powered chargers, ReRoot ID and Wallet Platforms, Monitoring and research tools **Institutional Resources**: Curriculum and multilingual microlearning digital content, NGO learning hubs, Mobile registration units **Financial Resources:** Philanthropic and donor funding, Partnerships with humanitarian and development organisations	**Phase 1: Onboarding** - Biometric Onboarding for ReRoot ID - Community orientation on privacy and usage **Phase 2: Learning Access** - ReRoot Wallet access - Delivery of microlearning via ReRoot Wallet **Phase 3: Local Facilitation** - Train facilitators - Facilitators help with peer mentoring at learning hubs - Engage NGOs to provide ongoing facilitation **Phase 4: Sharing and Progression** - Issuance of Portable Credentials - Exploring opportunities for jobs, internships, national training schemes	Refugees and displaced learners Local facilitators (Training) Host-country employers and education institutions Technology support team Local NGOs for facilities	Increased digital literacy and confidence for refugees Access to proof of identity and learning for refugees Identity empowerment - Secure, non-state-linked digital identity	Job/education credentials for refugees Increased learner agency and self-efficacy Increase social inclusion	Refugee recognition Economic mobility for refugees - Better access to work and education across borders Empowered mobile and socially integrated communities for refugees

Figure 6.2: Logic Model Part 2

CHAPTER 7: COST ANALYSIS AND ROSOURCE ALLOCATION

The proposed ReRoot Futures pilot prioritizes scalable impact and cost-efficiency through a modular deployment model tailored to Malaysia context. Targeted for implementation in key refugee-hosting areas—Kuala Lumpur, Selangor, Penang, and Johor Bahru—the pilot focuses resources on two pillars: biometric identity registration and vocational education delivery via community-based learning hubs.

To reduce infrastructure costs, the project will partner with existing humanitarian and civil society networks to repurpose trusted venues such as public libraries, university campuses, and NGO facilities (e.g., MSRI, Tzu Chi, MERCY Malaysia, and the Malaysian Red Crescent). Using these spaces during off-hours minimizes capital outlay, fosters integration, and accelerates real-world implementation.

The pilot is strategically designed to maximize impact while maintain low operational costs. Its modular and scalable structure ensures adaptability across diverse humanitarian settings. The program directly addresses two key gaps—legal identity and disrupted education—through targeted investment in biometric enrolment and skill-based learning delivery.

By leveraging existing public infrastructure like libraries and schools during off-hours, the program keeps venue costs low while fostering community acceptance. Tablets are prioritized over laptops for portability, low power use, and user-friendliness.

Though biometric systems require initial investment, they offer long-term benefits through secure, paperless identity verification and reduced fraud.

By aligning with local labour market needs, the structured vocational curriculum enhances refugees' employability and digital literacy. The modular content and asynchronous delivery promotes self-paced learning and long-term self-reliance.

With a total cost of $21,499 as indicated in the breakdown of Table 7.1, the pilot can serve 100 learners per 6-month cycle, with infrastructure built to accommodate more. Its scalable design and local partnership model support cost-effectiveness and long-term sustainability.

Component	**Item Description / Example Brand**	**Unit Cost (USD)**	**Quantity**	**Subtotal (USD)**	**Function & Key Features**
Biometric Enrolment					
Fingerprint Scanner	Suprema BioMini Slim 3 / SecuGen Hamster Pro	$300	1	$300	High-resolution (500+ dpi) fingerprint capture; USB-powered; supports secure identity enrollment.
Facial/Iris Scanner	IriTech IriShield USB MK2120U	$1,500	1	$1,500	Dual-eye iris scanner with IR camera; reliable in low light; compact and rugged for field use.
Enrolment Laptop	Dell Latitude 3440 (Secure OS, TPM chip)	$1,000	1	$1,000	Runs enrollment software; includes encryption (TPM), secure OS; serves as control hub for biometric devices.
UPS + Solar Backup	EcoFlow River 2 + 100W Solar Panel Kit	$800	1	$800	Portable power for off-grid use; ensures uninterrupted operation of devices; rechargeable and solar-compatible.
Training for Enroller	Onboarding & data privacy protocols	$500	1 staff	$500	Local staff training on biometric procedures, consent, and UNHCR-compliant data handling.

Queue Management	2 local facilitators @ $300/month	$300	6 months	$1,800	Maintains orderly enrollment flow; supports communication with participants in local language.
Enrollment Assistant(s)	Local assistants to support biometric operations	$250/month	2 × 3 months	$1,500	Support queue control, device handling, data entry; improve speed and reduce operator burden.
Software Development	Custom biometric registration portal (open-source based)	$3,500	1 setup	$3,500	Enables offline/online biometric capture; encryption-compliant; adaptable to local language and server needs.
Cloud Storage & Sync	Encrypted cloud storage (e.g., AWS S3, Firebase)	$250	1 year	$250	Secure data backup & syncing; allows restoration and cross-site coordination; scalable cloud access.
Learning Stations					
Venue	Public library/school (nominal rent or in-kind)	$100	6 months	$600	Cost-effective location; fosters host-refugee interaction; uses existing infrastructure.

Tables and Chairs	IKEA BJURSTA Set or local equivalent	$50	10 sets	$500	Basic furnishing for training; light, stackable, suitable for flexible classroom setups.
Tablets (preloaded)	Samsung Galaxy Tab A8 10.5” (Wi-Fi, 64GB)	$200	20 units	$4,000	Portable e-learning device; camera function; preloaded content; low power use; ideal for offline study and assessments.
Classroom Fans	Midea FS40-15QR Standing Fan (or wall-mounted fan)	$50	3 units	$150	Ensures ventilation and comfort in warm settings; quiet and energy efficient.
Local Trainer Honorarium	1 trainer @ $400/month	$400	6 months	$2,400	Deliver lessons; support learner engagement; local trainer enhance contextual relevance and trust.
Monitoring & Reporting	Survey tool setup (Google Forms, Data Studio)	$500	1 setup	$500	Enables program tracking, feedback, and outcome reporting; visual dashboards for funders/stakeholders.
Instructional Design Support	Freelance consultant for content design and LMS adaptation	$1000	1 course	$1,000	Ensures learning material is tailored to refugee learners and aligned with job market needs.

Authoring Tool License	Articulate 360 (Storyline + Rise, 1-year educator license)	$1,399	1 license	$1,399	Industry-standard tool for interactive course creation; enables SCORM/xAPI export, multimedia content, responsive design.
LMS Coordination	Part-time coordinator for LMS updates and learner tracking	$400	2 months	$800	Oversees platform use, manages digital classes and tracks learner progress.
TOTAL	$21,499				

Table 7.1: Pilot Deployment – Resource Breakdown and Estimated Cost

10-Year Maintenance and Scalability Estimate

Ensuring the long-term viability of ReRoot Futures require proactive planning and resource management. The following table 7.2 represents a conservative 10-year estimate for operating nad maintaining a single permanent learning hub. This is base on pilot outcomes and inflation-adjusted recurring expenses:

Category	**Annual Cost (USD)**	**10-Year Estimate**
Equipment Maintenance (devices, fans, scanners)	$500/year	$5,000
Software Updates + Data Storage	$300/year	$3,000
Staff Salaries (trainer + admin)	$6,000/year	$60,000
Utilities + Consumables	$800/year	$8,000
Refresher Training + Retraining	$500/year	$5,000
Replacement Tablets (25% per 3 yrs)	$1,000 every 3 years	~$3,000
Monitoring and Reporting	$600/year	$6,000
Total	~$90,000	

Table 7.2: Pilot Deployment – Resource Breakdown and Estimated Cost

The initial six-month pilot is estimated at $21,499 per hub, serving 100–200 learners monthly on a rotating schedule. With five hubs, the program will reach 500–1,000 users, generating valuable insights to refine content, enhance delivery, and assess effectiveness before scaling. Each site’s ten-year

maintenance cost is projected at $90,000, sustaining access for thousands of learners. This phased, cost-conscious strategy ensures strong long-term returns by fostering employment readiness, economic self-reliance, and reducing dependency on humanitarian aid.

Evaluation of the Learning Package

The educational component of ReRoot Futures focuses on building strong theoretical foundations to support refugees' economic reintegration and long-term self-sufficiency. To assess learning outcomes, a dual-layered framework will be used. Formative assessments—including quizzes, scenario-based questions, and reflection journals—will be embedded in daily sessions to track understanding and provide ongoing feedback. Summative assessments will involve written evaluations, case analyses, project presentations (e.g., care routines or service workflows), and self-assessment rubrics. Pre- and post-course evaluations will measure gains in job-related knowledge and employability readiness.

Workplace readiness will be validated through partnerships with employers, NGOs, and training centers offering short-term internships. These applied experiences will allow learners to demonstrate the transfer of theoretical knowledge into professional practice.

Success will be measured not only by knowledge acquisition but also by the learner's ability to apply skills in real contexts—through employment, internships, micro-enterprises, or certification pathways. This outcome-oriented approach addresses displaced individuals' core priorities—stability, dignity, and the ability to rebuild—and directly supports Sustainable Development Goal 8 (Decent Work and Economic Growth), delivering long-term benefits to both refugee communities and host economies.

Operational Risk Assessment and Mitigation

While the ReRoot Futures learning platform is designed to minimize infrastructure demands and integrate with existing systems, several operational risks remain. One key concern is potential resistance from host governments toward biometric registration or structured education programs for displaced populations. This risk is considered moderate, especially in contexts where biometric

technologies are politically sensitive or refugee policies are under review. Such resistance could delay implementation, restrict regulatory approvals, or reduce institutional and public support.

To mitigate this, the project will engage proactively with national refugee councils, education ministries, and digital transformation agencies to ensure alignment with local policies and legal frameworks. Emphasis will be placed on the voluntary nature of biometric registration, guided by informed consent and adherence to international data protection standards such as the UNHCR Data Protection Guidelines.

The pilot will be framed as a non-permanent, opt-in initiative using existing community or government facilities. It will feature a clear exit strategy and a scalable design, minimizing perceptions of permanence or intrusion. To build trust and demonstrate value, early monitoring will focus on tangible outcomes—such as enhanced digital literacy, improved service access, and better-targeted support—providing evidence for long-term policymaking.

Other Risks and Mitigation Measures

Risk Category	**Likelihood**	**Mitigation Strategy**
Lack of Internet Connectivity	Medium	All learning content will be preloaded on devices to ensure offline access. Progress and usage data will sync automatically when connectivity becomes available.
Community Resistance (Host Population)	Low	Activities will be conducted in shared public spaces (e.g., libraries, schools). Local facilitators will be hired, and ongoing community outreach will promote transparency and trust.
Device Security Concerns	Medium	Deice security will be maintained through individual device assignments, asset tracking systems and availability of secure storage facilities at learning hubs.
Answer fraud through peer copying	Medium	Use randomized question banks, time limits, and adaptive sequencing to prevent answer sharing and reduce predictability.

Identity Fraud / Impersonation	Medium	System will use both facial and fingerprint recognition for login or assessments. This will be supported by secure activity tracking and access controls to protect data and ensure authenticity.
High Staff Turnover	Medium	Modular, short-term training and clear Standard Operating Procedures (SOPs) will ensure continuity and allow new staff to integrate quickly with minimal disruption.

The pilot is built with a proactive understanding of mostly moderate, manageable risks, addressed through existing technologies and local strategies. Practical, cost-effective mitigation measures ensure smooth implementation and create a strong foundation for future scaling in diverse, low-resource settings.

CHAPTER 8: CONCLUSION

To bridge the persistent, disconnect between identity, education, and opportunity in refugee contexts, this project proposes ***ReRoot Futures***—a dual-pillar, integrated digital ecosystem designed to restore agency, build relevant skills, and unlock pathways to socio-economic reintegration.

At its core, ReRoot enables refugees to manage a biometric digital identity and a portable learning wallet that grants access to services, verifies credentials, and supports independent reintegration.

More than a technological solution, *ReRoot Futures* is a rights-based framework that treats identity, education, and mobility as interdependent human rights. By combining secure biometric systems with adaptive, localized learning tools, ReRoot addresses two of the most entrenched barriers to refugee recovery: legal invisibility and disrupted education.

Its modular structure ensures adaptability across contexts—from onboarding and asynchronous learning to vocational training and youth development—equipping displaced individuals with the skills, confidence, and credentials for long-term self-reliance. The model affirms that sustainable recovery requires structural transformation, not fragmented aid.

We call on the **United Nations**, **host governments**, **NGOs**, and the **private sector** to adopt and invest in the ReRoot model. Its success depends on collaborative commitment to shared goals of dignity, opportunity, and resilience.

In a world where forced displacement has reached record levels, ReRoot Futures offers a bold, practical vision of what integration can truly mean—one where refugees not only survive, but thrive.

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APPENDIX A: LESSON PLAN SAMPLE

Lesson Plan Example	
Topic	Customized Language Learning Module - Basic Communication Skills for Host Country Integration
Session	English/Bahasa Melayu Basic Communication Training (Self-paced Learning)
Instructor	Self-directed learning with AI voice recognition guidance and online community support
Objectives	● Master daily basic greetings and social etiquette for fundamental social interactions ● Establish basic sentence structure and grammar application abilities to form correct language expression habits ● Develop fast daily conversation and emergency communication skills to meet basic life communication needs ● Acquire culturally adaptive language expression abilities and understand cultural contexts behind language use
Materials Needed	● Access to Learning Management System for the Asynchronous Online Instructional Package ● Stable Internet Connection to access the instructional package, asynchronous online discussion (Padlet) and participate in online community ● Smartphone or Tablet to download necessary applications and scan QR codes for interactive activities
Assessment & certification	Progress recorded through ReRoot Wallet, complete all modules and pass comprehensive language communication test to earn "Basic Language Communication Skills" micro-credential

Module Arrangement		
Module	**Activities**	**Navigation**
Simple Greetings & Social Etiquette	**Video Learning:** Watch 5-minute greeting scenario videos with native language subtitles (store, hospital, school scenarios **Pronunciation Practice:** Repeat and follow 15 core greeting phrases like "Hello/Good morning/How are you" **Voice Recognition Test:** System evaluates pronunciation accuracy with instant feedback **Cultural Annotations:** Learn non-verbal communication etiquette like handshakes and eye contact **Interactive Practice:** Scan QR codes for virtual greeting scenario practice **Community Sharing:** Share cultural differences in greetings from home countries on Padlet	**Entry Requirement:** Complete registration phase **Progress Tracking:** Voice recognition accuracy must reach 80% **Unlock Standard:** Complete 15 greeting practices and pass cultural understanding quiz **Review Mechanism:** Unlimited practice repetition available
Basic Sentence Foundation	**Grammar Videos:** Learn basic subject-verb-object structure (I am/I have/I need/I want) **Fill-in-the-blank Exercises:** Complete 50 sentence pattern exercises covering self-introduction and basic needs expression **Sentence Reconstruction:** Rearrange scrambled words into correct sentences **Life Application:** Record 30-second self-introduction video with system grammar assessment **Error Correction:** AI assistant provides personalized grammar error analysis **Peer Interaction:** Practice basic conversations with other learners through voice messages	**Entry Requirement:** Complete basic greetings module **Competency Check:** Sentence pattern accuracy rate above 75% **Practice Assessment:** Successfully record qualifying self-introduction **Advancement Prep:** Master 20 common sentence templates

Fast Talk & Daily Conversation	**Scenario Simulation:** Participate in 6 real conversation scenarios (shopping, asking directions, appointments, seeking help) **Role Playing:** Alternate customer/service provider roles in 3-minute conversation practice **Rapid Response:** Quick response training for 30 common questions (respond within 10 seconds) **Speed Training:** Progress from slow speed (0.7x) to normal speed (1.0x) **Emergency Expression:** Learn key phrases and help-seeking expressions for emergency situations **Comprehensive Dialogue:** Complete 5-minute unscripted free conversation challenge **Achievement Showcase:** Record complete conversation video solving real-life problems	**Entry Requirement:** Pass sentence construction assessment **Fluency Assessment:** Conversation response time <15 seconds **Comprehension Ability:** Correct response rate reaches 70% **Final Certification:** Pass 5-minute comprehensive conversation test **Micro-credential:** Earn "Basic Language Communication Skills" certification