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Computing Perceptions of Street-Connected Youth in Nigeria

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Research Article

Keywords: street-connected youth, broadening participation in computing, AI, Internet, programming, computing perceptions, Africa

Posted Date: September 11th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-10513319/v1

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Additional Declarations: Competing interest reported. The first author is employed by School In The Street (SITS), the non-governmental organisation where this study was conducted. The remaining authors declare that they have no competing interests (financial or non-financial).

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Abstract

Computing education research has increasingly emphasised broadening participation for underrepresented groups. Yet street-connected youth, one of the most socially and educationally marginalised young people globally, remain absent from both computing education scholarship and digital inclusion efforts. This study explores how street-connected youth construct meanings around four foundational computing concepts, computer, internet, programming and artificial intelligence, within their lived experiences. A qualitative exploratory design was employed, using Draw-and-Tell Conversations and semi-structured interviews with ten street-connected young people affiliated with a non-

governmental organisation in Lagos, Nigeria. Data were analysed thematically. Three themes characterised participants' computing meaning-making. Theme 1 revealed that participants framed computing primarily as a tool for economic survival, valuing digital technologies for their income-generating potential, including fraudulent practices, without ethical framing or moral concern. Theme 2 documented fragmented understandings across all four computing domains. Participants could recognise computing artefacts without grasping the principles underlying them, and familiarity with AI applications markedly exceeded understanding of programming. Theme 3 established exposure as the primary mechanism through which computing understanding and aspiration were formed, with observational encounters in everyday environments, particularly with socially proximate peers, generating imagined computing futures that participants' knowledge could not yet support. The findings extend broadening participation in computing to an overlooked population and demonstrate that computing education designed for street-connected youth must engage with the survival-oriented meaning systems participants already hold, embed digital ethics as a foundational and applied curriculum component and build on existing aspirational orientations rather than assuming motivation needs to be created.

Keyword: *street-connected youth, broadening participation in computing, AI, Internet, programming, computing perceptions, Africa*

1.0 Introduction

1.1 Computing education as a global imperative

In contemporary society, computing knowledge has increasingly become a foundational form of literacy, shaping participation in education, employment, communication, and innovation (National Academies of Sciences, Engineering, and Medicine, 2026; Tinmaz et al., 2022; World Economic Forum, 2025). Its significance is deeply embedded in everyday life, extending from household routines to complex institutional and economic systems where digital technologies mediate how people work, learn, interact, and solve problems. Beyond functional engagement with technology, computing literacy increasingly encompasses the ability to understand and create computational solutions, with programming serving as a critical avenue for creative expression, logical reasoning, and problem solving (Mills et al., 2025; Rao & Bhagat, 2024; Tinmaz et al., 2022).

Several studies including, Sunday et al. (2025), Pena and Rosson (2019) and Lev-On et al. (2021) have shown how competence in programming, enabled individuals move from being passive consumers of technology to active creators of digital artefacts and solutions. At the same time, the growing integration of artificial intelligence into social, educational, and economic systems has expanded the scope of computing literacy, positioning AI understanding as an emerging competence necessary for navigating algorithmically

mediated environments (Chiu et al., 2024; Eder & Sjøvaag, 2024; Gómez García et al., 2026; Odukale, 2024). Similarly, the internet continues to function as a core infrastructure for information access, communication, and participation in digital communities, making internet literacy inseparable from broader computing competence. These developments position computing knowledge as an essential literacy for meaningful participation in the current digitalised world.

In response to this reality, computing education has expanded significantly across K–12 schooling, higher education, and non-formal learning environments, driven by policy commitments, curriculum reforms, and grassroots initiatives aimed at equipping diverse learners with foundational computing knowledge (Gardner et al., 2022; Kafai & Proctor, 2022; Pérez-Escolar & Canet, 2023; Sanusi & Deriba, 2024). While opportunities for computing education have expanded, participation remains deeply shaped by social, economic, and structural inequalities. Recent studies on global disparities argue that access to computing learning is unevenly distributed, with disparities in technological resources, educational infrastructure, and social support creating unequal pathways into computing participation (Barik, 2025; Fang & Nie, 2025; Guo & Ogbodo, 2026; Martin et al., 2026; Wheatley, 2024). This reality is reflected in persistent imbalances in digital literacy and computing access across population groups worldwide.

In high-income countries, 93% of the population uses the internet compared to just 27% in low-income countries, and fewer than 1 in 20 school-age children from low-income households have internet access at home compared with nearly 9 in 10 from high-income countries Globally, 94% of people in high-income countries use the internet compared to just 23% in low-income countries, and fewer than 1 in 20 school-age children from low-income households have internet access at home compared with nearly 9 in 10 from high-income countries (International Telecommunication Union (ITU), 2025; UNICEF & ITU, 2020). In Nigeria, where this study is situated, internet penetration stands at approximately 50%, meaning half the population remains unconnected (Nigerian Communications Commission, 2025). This implies that for many young people from economically disadvantaged or socially marginalised backgrounds, access to devices, connectivity, and quality computing instruction remains limited, constraining early exposure to foundational computing knowledge (Adegoke, 2022; Martin et al., 2026; Ogunkan, 2026). Street-connected youth represent a particularly acute case within this broader pattern. Their lives

are characterised by homelessness, economic precarity, and severely disrupted or absent schooling, conditions that position them among the most computationally excluded groups in low- and middle-income contexts (Abekah-Carter et al., 2024; Embleton et al., 2020; Gabriel, 2026). Beyond access, participation barriers including financial constraints, low digital confidence, and limited institutional support further restrict sustained engagement in computing learning (Gardner et al., 2022; Helsper, 2011; Pérez-Escolar & Canet, 2023), and these barriers are compounded by the structural conditions of poverty and social exclusion that define street connection itself (Ogunkan, 2026).

Yet this population remains absent from the very literature that documents digital exclusion. A systematic review of digital inclusion efforts across marginalised populations did not include street-connected youth within its taxonomy of excluded groups (Pérez-Escolar & Canet, 2023). This is not a minor sampling limitation; it reflects a field-level blind spot about who is recognised as a candidate for digital inclusion in the first place. Individual studies corroborate this pattern. Focus group research on vulnerable populations examined ethnic minorities, older people, and people with disabilities (Tsatsou, 2022), and a large-scale household survey identifying those at highest risk of digital exclusion reached deaf community members, mothers experiencing domestic violence, and unemployed young men (Wilson-Menzfeld et al., 2025). Street-connected youth appeared in none of these frames. Their absence from the digital inclusion literature is not deliberate; it mirrors the structural invisibility that defines their exclusion from society more broadly. This epistemic marginalisation compounds their material one. Despite growing recognition of computing literacy as essential for participation in contemporary society, how street-connected youth understand foundational computing concepts (including internet, computer, programming and artificial intelligence) remains largely unexamined. This study produces that evidence, examining how street-connected young people in Nigeria understand and make sense of foundational computing concepts as a necessary precondition for broadening computing participation to a population the field has yet to recognise.

1.2 Research Questions

1. How do street connected youth conceptualise and make meaning of foundational computing concepts, including computers, the internet, programming, and artificial intelligence?

2. What factors shape street connected youths' perceptions and understandings of foundational computing concepts?

2.0 Literature Review and Theoretical Framework

2.1 Theoretical Framework

This study is grounded in social constructivism, which posits that knowledge is actively constructed through social interaction, cultural mediation, and engagement with material and symbolic resources rather than passively acquired (Cobb, 1994; Vygotsky, 1978). From this perspective, understandings of foundational computing concepts such as the computer, the internet, programming, and artificial intelligence are not universal or stable, but are shaped through learners' situated interactions with digital technologies, observations of others, and the cultural narratives that circulate within their environments. Building on Lave and Wenger's (1991) notion of situated learning, meaning-making is understood as inseparable from the contexts in which it occurs. For street-connected youth operating outside formal educational structures, this framework offers a means of understanding their computing perceptions as contextually produced rather than measuring them against institutional norms

2.2 Broadening participation in computing

Addressing inequities in computing participation has become a central concern within computing education research, particularly through the growing emphasis on broadening participation in computing (BPC). Scholars and policymakers define BPC as deliberate efforts aimed at increasing access, representation, and meaningful engagement in computing among groups historically underrepresented or excluded from computing pathways (Margolis et al., 2012; Melton & Rorrer, 2024; National Science Foundation, 2021). Beyond numerical inclusion, the concept emphasises equity in learning opportunities, access to resources, and the creation of supportive environments that enable diverse learners to develop computing knowledge and skills. Within computing education, this agenda has gained prominence as scholars and practitioners increasingly recognise that participation in computing is shaped not only by individual interest or ability but also by structural, social, and educational conditions that influence access and engagement (Barik, 2025; Johnson et al., 2023). Consequently, broadening participation has become both an educational and social justice imperative, seeking to dismantle barriers that restrict entry

into computing and to expand opportunities for diverse forms of participation. This focus has stimulated interventions aimed at making computing education more inclusive across different learner populations.

In formal schooling contexts, Goode et al. (2020) demonstrate that initiatives such as Coding as Another Language, when embedded within early elementary curricula, contributed to increased engagement, confidence, and computing identity formation among younger learners from low-SES backgrounds and girls. Beyond the classroom, non-formal programmes have extended computing participation to highly marginalized populations. For refugee and displaced learners facing systemic educational disruptions, structured digital learning initiatives have shown promise in rebuilding foundational computing skills and confidence (Jellema et al., 2023; Nicolai et al., 2023). Similarly, learners with disabilities have been supported through non-formal interventions such as tactile programming interfaces and assistive technology-supported code clubs, enabling meaningful engagement with computational concepts (Barbareschi et al., 2020; Koushik & Kane, 2019; Milne & Ladner, 2018). At the informal and community level, workshop-driven and interest-based initiatives in underserved settings have strengthened digital skills, self-efficacy, and problem-solving capacities among low-SES and economically marginalized learners outside formal educational pipelines (Johnson et al., 2023; Lev-On et al., 2021). These studies reflect the field's growing commitment to inclusive computing education by designing pathways for populations historically excluded from computing participation.

However, this expanding body of work also reveals important boundaries in who is recognised within broadening participation efforts. Much of the existing literature on inclusive computing education identifies some level of institutional attachment, whether through schools, community programmes, organised workshops, or structured support systems thereby centring learners who remain at least partially connected to formal or semi-formal educational pathways (Gardner et al., 2022; Martin et al., 2026; Sanusi and Deriba, 2024). This approach leaves a critical gap in understanding the computing experiences of young people whose lives exist entirely outside these structures and whose educational trajectories are marked by disruption, instability, and social exclusion. For such youth, exclusion from formal education frequently overlaps with digital exclusion, limiting both access to computing opportunities and visibility within computing education research (ITU, 2025; UNICEF & ITU, 2020). As a result, the field's current understanding of broadening participation remains incomplete as some of the most educationally and socially marginalised young people continue to fall outside dominant research and intervention

agendas, their experiences neither studied nor designed for. Among such populations, street-connected youth remain notably absent from computing education scholarship.

2.3 Street connected youths as an overlooked computing education population

Dominant policy and scholarly narratives frequently frame street-connected youth through the lens of digital exclusion, positioning them as lacking access, skills, or meaningful engagement with digital technologies (Helsper, 2011; Adegoke, 2022). While such framings correctly identify structural inequities, they risk obscuring the empirical reality of active digital participation under conditions of constraint. Across multiple studies, street-connected youth demonstrate consistent and often intensive engagement with digital platforms, albeit through unstable and improvised means. Selfridge (2016) reports that 94% of street-involved youth in British Columbia used Facebook, while Harpin et al. (2016) similarly found high levels of social media engagement alongside substantial mobile phone ownership. Lal et al. (2021), in a scoping review of youth experiencing homelessness, further confirm that smartphones and social media platforms are routinely used for essential survival tasks, including seeking housing, employment opportunities, health information, and social support. This body of evidence challenges deficit-based assumptions of non-participation and instead foregrounds a pattern of constrained but persistent digital engagement.

However, high reported usage rates should not be conflated with stable or equitable access. Kim (2014) provides a more insight into the precarity underpinning mobile phone use among homeless populations, highlighting persistent challenges such as device theft, inconsistent charging opportunities, unstable prepaid service plans, and the absence of secure storage. Jennings et al. (2016) similarly document how financial insecurity, interpersonal conflict, and safety concerns disrupt continuity of access among homeless youth, reinforcing the fragile conditions under which digital participation is maintained. Humphry (2022) synthesises these dynamics by conceptualising homelessness as a deeply mediated condition in which smartphones function as essential “lifelines” for maintaining relationships, accessing services, and navigating survival. Yet this connectivity remains inherently precarious, with those most dependent on digital technologies also being those most vulnerable to loss of access. Rather than indicating inclusion, digital engagement in this context is better understood as a continuous process of maintaining connectivity under structural instability.

Beyond survival-oriented use, the literature also highlights the social and identity functions of digital engagement. Mobile phones and social media platforms enable street-connected youth to maintain family relationships, manage stigma, and construct socially legible identities in contexts where offline legitimacy is often compromised (Le Dantec, 2008; Jennings et al., 2016; Ahn & IEEE, 2019). In addition, some youth develop informal peer-based digital expertise, acting as mediators who assist others with basic troubleshooting and navigation of digital tools within shelters and community settings (Radó et al, 2024). This indicates that digital engagement is not merely consumptive but also socially productive, involving forms of relational and situated digital competence developed under conditions of constraint.

Evidence from intervention-based studies further suggests that structured digital engagement can produce measurable developmental benefits among this population. Hendry et al. (2011) demonstrate that a targeted digital media curriculum delivered in drop-in centres enhanced participants' life skills, self-worth, and engagement with adult support systems. Similarly, Calvo and Carbonell (2018) show that participation in Facebook-based training significantly improved social skills, self-efficacy, and self-esteem compared to traditional software training approaches. These findings indicate that when access is stabilised and supported, street-connected youth are capable of deriving substantial educational and psychosocial benefits from computing-related learning experiences. Nevertheless, such interventions remain limited in scope and are rarely embedded within broader frameworks of computing education or long-term digital development pathways.

A further body of work extends the analysis from individual use to institutional and infrastructural dimensions of computing. Pye et al. (2005) examine the implementation of the Homeless Individuals and Families Information System (HIFIS) in Canada, demonstrating how ICT systems are used to coordinate shelter services and produce structured knowledge about homelessness. This position computing not only as a personal resource but also as a mechanism of institutional governance. Similarly, Radó et al. (2024) identify heterogeneity within homeless populations, showing that a subset of digitally engaged individuals function as informal peer mediators within shelters, thereby revealing uneven distributions of digital literacy and capability. Tan et al. (2017) further illustrates how interactive computing systems can mediate civic relationships between homeless individuals and the wider public, positioning digital technologies as infrastructural tools that

shape participation, visibility, and resource distribution. These studies highlight that street-connected youth are embedded within computing systems that extend beyond personal device use into institutional, civic, and algorithmically mediated infrastructures.

Despite the breadth of evidence documenting digital engagement, existing research overwhelmingly focuses on access, communication practices, health information seeking, and survival-oriented use. Far less attention has been directed toward how street-connected youth understand computing concepts, develop computational identities, or conceptualise their relationship to technological systems. Digital participation is thus primarily interpreted through lenses of social inclusion, health behaviour, or employability rather than through computing education or epistemological engagement with technology itself. This omission is significant, as it limits understanding of how marginalised learners interpret the very systems they actively navigate.

This gap is further complicated by geographical bias within the literature. The majority of empirical studies originate from Canada, the United States, and Europe, contexts in which digital infrastructure, welfare systems, and institutional support structures provide at least partial scaffolding for connectivity (Selfridge, 2016; Humphry, 2022; Wang, 2025). By contrast, considerably less is known about street-connected youth in the Global South, where infrastructural instability, economic precarity, and institutional fragility are often more pronounced. As Adegoke (2022) argues, assumptions of transferability between Global North and South contexts risk obscuring the structural specificity of digital exclusion. Consequently, existing evidence may overrepresent forms of constrained inclusion that are only possible within relatively resourced environments, limiting its ecological validity for contexts across much of sub-Saharan Africa and other low-resource settings.

The literature reveals a complex picture of street-connected youth as active but constrained digital participants who develop adaptive literacies under conditions of structural inequality. However, while their digital practices are well documented, their computational understanding remains largely unexamined. This absence is particularly significant given that computing systems increasingly structure not only communication but also access to services, identity formation, and civic participation. Reframing street-connected youth as a legitimate computing education population therefore requires moving beyond deficit-oriented narratives of exclusion toward a more comprehensive understanding of their existing digital practices, emergent competencies, and interpretive frameworks. Such a shift

is essential for developing inclusive computing education models capable of engaging learners whose experiences of technology are shaped by survival, improvisation, and systemic constraint rather than formal instruction.

2.4 Foundational Computing Concepts

Research on young people's perceptions of foundational computing concepts shows that understanding of computing develops long before formal instruction and is shaped primarily through everyday exposure, observation, and cultural mediation (Lipnická, 2026; Mertala, 2020; Edwards et al., 2018). Across studies, children tend to construct functional and experience-based understandings of digital technologies, perceiving computers as tools for communication, learning, and entertainment rather than as programmable systems with underlying computational logic (Lipnická, 2026). Similarly, the internet is often understood in terms of its uses rather than its structure, with young learners describing it as a space for accessing content or connecting with others rather than a networked infrastructure (Wei and Chou, 2020). These findings suggest that early computing perceptions are socially formed and grounded in observable interaction rather than formal technical knowledge.

This pattern extends across specific computing domains, although the nature of understanding varies. Programming is commonly perceived as an activity associated with games, creativity, or controlling digital devices rather than as formal computational reasoning (Yu and Roque, 2022). Even where learners encounter structured instruction, their understanding often remains procedural, with problem solving based on trial and error rather than systematic abstraction (Wong and Cheung, 2018). Artificial intelligence is similarly shaped by indirect exposure, with young people frequently associating AI with robots, human like intelligence, and autonomous agency (Chang et al., 2026; Jabraoui and Vandapuye, 2024). While some learners expressed optimism about AI's educational value, misconceptions and anthropomorphic interpretations remain dominant (Ivančić et al., 2025). These studies indicate that perceptions of computing are socially constructed through exposure to cultural narratives rather than grounded in conceptual or technical understanding.

The significance of these perceptions lies in their influence on how young people position themselves in relation to computing. Prior research suggests that confidence, familiarity, and perceived relevance of digital technologies shape willingness to engage with computing

practices and learning opportunities (Wei and Chou, 2020). Where computing is perceived as complex, specialised, or socially distant, learners may be less likely to see it as accessible or relevant to their identities. Conversely, where computing is experienced as familiar and socially embedded, engagement becomes more likely. This highlights perception as a foundational dimension of digital literacy and participation in computing education.

However, the existing literature is heavily concentrated in school based and relatively stable access contexts. Even studies conducted in low resource environments typically involve children within some form of educational structure, leaving limited understanding of how computing perceptions develop outside formal schooling systems. While Oyedoyin et al. (2025) provides insight into children in an out of school African context, demonstrating that programming and artificial intelligence may remain entirely unrecognised in such environments, broader empirical evidence on perception formation under conditions of extreme precarity remains scarce. As a result, current knowledge is limited in its ability to explain how foundational computing concepts are understood in contexts where access is intermittent, informal, and shaped by survival-oriented engagement with technology.

This gap is particularly significant for broadening participation in computing. Without understanding how marginalised young people perceive foundational computing concepts, particularly in contexts outside formal education, computing education risks designing interventions based on incomplete assumptions about prior knowledge, relevance, and conceptual readiness. Addressing this limitation requires extending research beyond stable educational environments to include street connected youth whose digital experiences are shaped by instability, improvisation, and constrained access. Understanding their perceptions is therefore essential not only for inclusion, but for developing more contextually grounded theories of computing learning and participation.

3.0 Methods

3.1 Research Design

This study adopted a qualitative exploratory design to achieve the research objectives. The study was guided by an interpretivist perspective, which assumes that meaning is constructed through individuals' lived experiences and social contexts. Data were

generated using a Draw and Tell Conversation approach complemented by semi structured interviews to obtain broader elaborations of participants' perspectives. The Draw and Tell Conversation approach integrates participant generated drawings with guided verbal explanations to access how individuals conceptualise abstract technological phenomena and has been widely applied in computing education research (Mertala, 2019, 2020; Oyedoyin et al., 2025)

3.2 Study Setting

The study was conducted at the Street in the School (SITS) Centre in Ikorodu, Lagos State, Nigeria. SITS is a registered non-governmental organisation that provides educational, vocational, and psychosocial support services for street-connected young people. The organisation was purposefully selected due to its long-standing trust relationship with street-connected youth, which was essential for gaining access to a highly mobile and vulnerable population whose engagement with external researchers is often shaped by caution, suspicion, and past negative experiences with adults and institutions outside their immediate social networks (Beazley, 2003; Conticini & Hulme, 2007; Ogunkan, 2026; Woan et al., 2013). The setting provided a familiar and stable context that supported participant engagement throughout the study process.

3.3 Participants

Fifteen participants were recruited from the SITS Centre using convenience sampling. Eligibility criteria included being street-connected, being aged at least ten years, and willingness to participate in all stages of the study. Written informed consent was obtained from all participants prior to participation.

3.4 Data Collection Procedure

Data collection took place at the mobile centre of SITS in September (11th to 14th) 2023 over four days. To minimise disruption to participants' regular economic and scavenging activities, the data collection activities fully replaced the centre's regular programmes, and all sessions were scheduled between 10:00 a.m. and 12:00 noon. Prior to the main data collection, awareness had been raised at the centre about the study and the planned computer training programme to support recruitment. On Day 1, the researcher briefed potential participants, obtained signed informed consent (and assent where applicable) from 15 individuals, and trained the SITS learning officer, who later facilitated activities

under the researcher's direct supervision and support. The study adopted a three-phase sequential data collection process consisting of drawing activities, Draw and Tell conversations, and semi-structured interviews. The schedule of activities is presented in Table 1. In all phases, data collection was conducted in a combination of English and Yoruba, reflecting participants' natural conversational practices. All Draw and Tell conversations and interviews were audio-recorded with consent.

Table 1: Schedule of activities

Day	Activity	Duration	Instructions / Focus	Outputs
1	Briefing & consent	30 min	Training of Learning Officer; debriefing of participants; informed consent	Trained facilitator; participant consent
2	Drawing session	20–45 min	"Please draw how you think about or imagine a computer, the internet, AI, and programming. No right or wrong answers."	Visual data (drawings); field notes
3	"Tell" session	45–60 min	"Can you describe your drawing and why you represented it this way?"	Audio-recorded narratives; transcripts
4	Individual interviews	45–60 min	Semi-structured probes into computing concepts	Transcripts of in-depth interviews

3.5 Materials and Instruments

Data were generated using participant produced drawings, Draw and Tell Conversations, and semi structured interviews. Participants were provided with plain paper, pencils, and erasers for the drawing tasks. The drawings were treated as elicitation artefacts rather than artistic products and were not assessed based on aesthetic quality. The Draw and Tell Conversation procedure was informed by Mertala (2019) and supported by recent applications in computing education research (Oyedoyin et al., 2025). Semi structured interview prompts were developed to extend exploration beyond the drawing-based discussions and capture participants' broader reflections on computing concepts.

3.6 Data Analysis

Each participant's drawing was paired with their immediate verbal explanation and then combined with the corresponding interview transcript to create a single integrated record. This approach ensured that visual, conversational, and interview data were preserved in context and analysed together, consistent with recommendations in visual methods research (Brailas, 2020; Banks, 2007). Audio recordings were transcribed and

subsequently translated into English for analysis. To preserve meaning, translations were reviewed alongside the original recordings during the transcription process. Thematic analysis followed Braun and Clarke's (2006;2022) six-step framework. Coding began with line-by-line review of the integrated records, allowing drawings, narrative explanations, and interview accounts to inform initial codes. Theme development was explicitly guided by methodological triangulation: insights from visual artefacts, DTC conversations, and interview data were compared and combined to strengthen validity and to capture participants' perceptions in fuller depth. This ensured that no single data source dominated interpretation, and that convergences as well as divergences were reflected in the final thematic structure. NVivo 12 was used to manage the dataset. Final themes were generated by grouping related codes across all three sources.

4.0 Result

4.1 Participant Characteristics

Fifteen participants were recruited, of whom five did not contribute usable data. Two withdrew during the drawing phase, stating they did not know what to draw, and three completed the drawing task but did not return for the Tell component. Since interpretation of the drawings was based solely on participant accounts rather than researcher inference, data from these three participants were excluded. The remaining ten participants completed all stages of data collection, yielding a completion rate of 67% (10/15). All participants were male, aged between 13 and 20 years, and had been living on the street for periods ranging from under one year to over a decade. The majority had completed secondary education (80%), and 30% reported prior exposure to computing education despite structural barriers including poverty and disrupted family circumstances, which were the primary drivers of street connection for most participants. All ten expressed interest in learning computing skills, with interests spanning software literacy, web design, graphic design, and e-commerce. Current vocations were predominantly informal, including scrap selling, load carrying, and artisanal trades. Full demographic characteristics are presented in Table 2.

Table 2: Demographic characteristics (n =10)

Variable	Category	n (%)
Age	13 – 17	6 (40)
	18 – 20	4 (60)
Gender	Male	10 (100)
Years on the street	Less than a year	2 (20)
	1 – 3	1 (10)

	4 – 6	3 (30)
	7 – 9	3 (30)
	10 and above	1 (10)
Level of education	Primary education	2 (20)
	Secondary education	8 (80)
Prior experience with computing education	Yes	3 (30)
	No	7 (70)
	Poverty	8 (80)
Circumstances leading to street life	Lack of educational opportunities	3 (30)
	Family issues	1 (10)
	Others (Personal convictions)	1 (10)
Interest in learning Computing/ICT skills	Yes	10 (100)
	Software Designing / Digital Literacy	4 (40)
	Website Designing	2 (20)
Specific interests in Computing/ICT	Graphics Designing	2 (20)
	Creating Ecommerce	1 (10)
	Hacking	1 (10)
	Scrap selling	5 (50)
	Load carrying	3 (30)
Current vocation	Aluminium Fabrication	2 (20)
	Barbing	2 (20)
	Others	4 (40)

4.2 Theme 1: Fragmented Digital Literacy

Across the four foundational computing concepts explored in this study, participants demonstrated partial and uneven understandings shaped more by incidental exposure than structured instruction. What the convergence of drawing, tell conversation, and interview data reveals is not simply that participants knew little, but that what they knew was coherently organised around the wrong frame. Their understandings were internally consistent but conceptually displaced, built from observable outputs and lived encounters rather than the principles that underpin each concept.

4.2.1 Computer

Drawings consistently depicted desktop configurations: monitors, keyboards, mice, and CPUs. The tell conversations, however, revealed that these representations were not anchored in functional understanding. Participants could name components but could not explain what they do, with the CPU described as a printing device, the mouse assigned the same function, and the monitor characterised as "the board of a computer." These were not random errors but a consistent pattern of reasoning from visible, surface-level interaction: *the keyboard is for typing, the monitor shows what you type, therefore these are what*

computers are. This frame was almost universally limited to desktop machines, and no participant spontaneously identified a smartphone as a computing device despite most owning or regularly using one. Several described daily smartphones use for income generation, social connection, and information access, yet this did not translate into recognising the device as a computer. The conceptual category of "computer" and the lived practice of computing were operating independently of each other. The one participant who did identify a smartphone as a computing device, correctly describing its memory, applications, and data functions, was also the one whose interview revealed the most sustained and purposeful personal engagement with computing: music editing, academic research, and professional observation of design work. His identification was grounded in the depth of engagement that the others lacked. Where exposure without purposeful use left most participants unable to recognise a device they used daily as a computer, sustained engagement produced conceptual clarity.

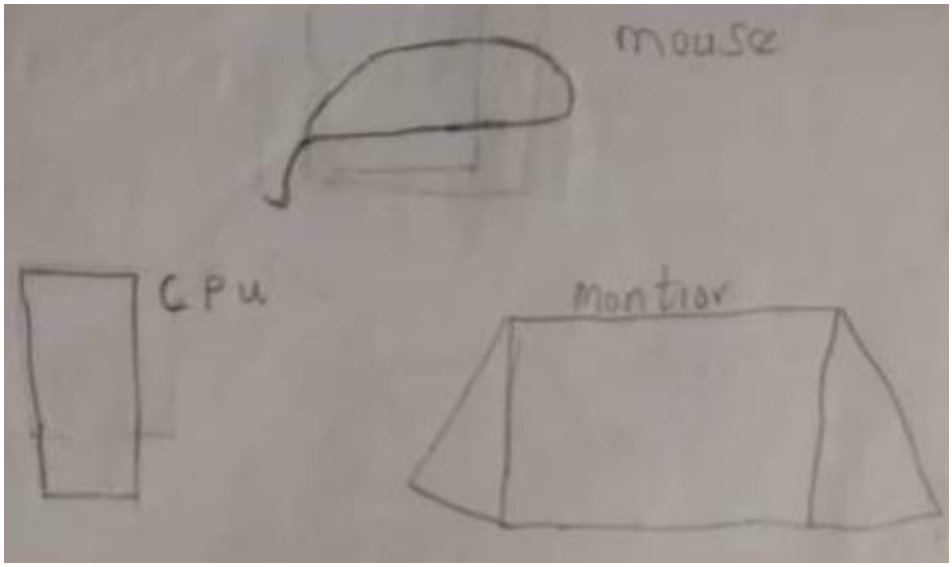


Fig 1 Participant's visual representation of a computer

4.2.2 Internet

The drawings produced the widest boundary confusion of all four concepts, and the tell conversations reveal why. Participants were not randomly grouping objects but applying a coherent, if incorrect, organising principle. To them, anything that connects devices belongs to the internet. One participant grouped DSTV dishes, DVD players, POS machines, ATM cards, and Spectranet under a single internet category, each justified by some form of device interconnection. Another included a megaphone as an internet tool on the grounds that it enabled secure connectivity (Fig 2). These accounts reflect not ignorance but a

coherent misapplication of the connectivity principle to every technology that links one thing to another. One participant whose drawing depicted ports and antennas as connectors, and whose tell conversation reflected the same boundary confusion, described in his interview how he had systematically used Instagram to photograph and share his construction work, attracting clients and generating income before losing access to his phone. That account is a sophisticated description of the internet as economic infrastructure, demonstrating competent functional use entirely at odds with the conceptual confusion visible in his drawing. Conceptual understanding of what the internet is and functional competence in using it are not the same thing, and in this population, they appear to develop independently of each other.

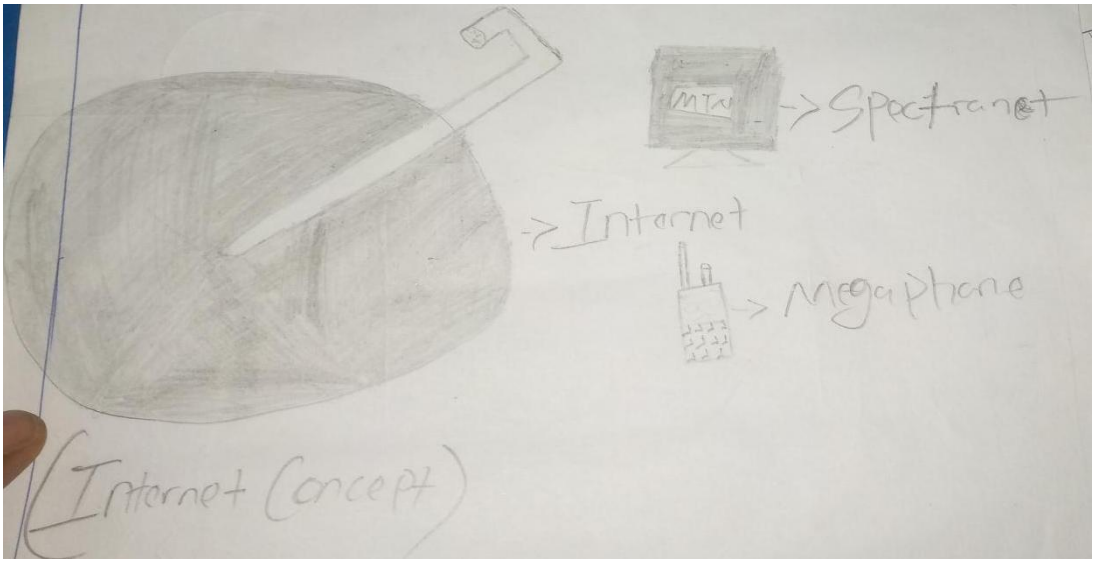


Fig 2 Participant's visual representation of the internet

4.3.3 Artificial Intelligence (AI)

Unlike the other three concepts, AI arrived in participants' drawings with breadth and specificity. Drawings depicted VAR systems, graphics generation tools, voice assistants, automated design applications, and traffic control systems, reflecting a range of culturally visible encounters that produced recognisable representational content (Fig 3). The tell conversations confirmed that these were not superficial associations. Participants could describe what these systems do, why they outperform human judgement, and how they connected to specific vocational contexts. Interview accounts extended this further into reflections on efficiency, employment, and future opportunity. Yet the interviews also exposed something the drawings could not: a recurring conflation between AI and mechanical automation more broadly. One participant described power tools replacing

manual tools as his primary AI example. Another described automated cloth printing machines in the same terms. A third explained that the connection between a smartwatch and an iPhone was possible because of AI. Each account applied the same underlying logic, machines doing what humans used to do, to phenomena that differ considerably in how they work. Participants were reasoning from the right principle while applying it beyond its proper boundary. One participant held a different position. His interview defined AI as computers performing tasks traditionally done by humans, connected it to VAR, voice search, and Google Assistant, and then turned that reasoning on himself. He acknowledged that his digital literacy was too basic to leverage AI effectively and expected it to affect his employment prospects adversely at that moment. That combination of conceptual clarity and honest self-assessment appeared nowhere else in the dataset.

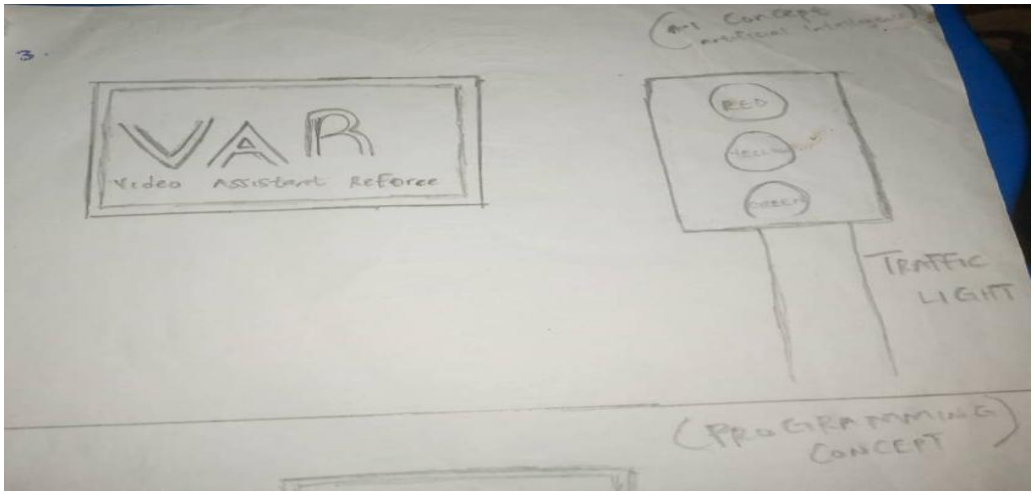


Fig 3 Participant's visual representation of AI application

4.4.4 Programming

Programming was the least understood concept across all participants, and the data reveals this in three distinct layers. The drawings almost universally depicted automated technologies rather than anything resembling code, software, or instructional design. Across participants, drawings included ATM machines, POS devices, sensor-activated doors, alarm clocks, calculators, robots, and clocks, each selected to represent something that works without direct human intervention (Fig 4). Notably, the ATM appeared as a recurring anchor across nearly every participant's drawing and tell conversations, reflecting how consistently a single observable technology shaped the conceptual frame being applied. The tell conversations revealed the organising logic behind these choices. Participants consistently explained their drawings through a single frame: these machines operate on their own, executing pre-set commands without requiring human presence at

the point of action. One described the ATM as programmed to pay money as long as the account has funds and the pin is correct. Another described sensor doors opening in response to fingerprints or ID cards as evidence of programming. A third explained that a robot can only work because it has been programmed. These explanations share a coherent internal logic: programming is what makes machines autonomous. That perception describes the product of programming accurately while leaving the process, the human act of designing, writing, and testing instructions, entirely invisible.

The interview data introduced a further layer that neither the drawings nor the tell conversations anticipated. For several participants, the word programming itself carried no computing association at all. One participant listed seven types of social programmes including church events, weddings, and naming ceremonies. Another described it as an activity someone wants to do, like demolishing or rebuilding something. A third constructed a definition from scratch during the interview: *something that has been pre-timed*. These accounts reveal that participants were not working from a partial or distorted understanding of programming. Rather, they were encountering the concept as entirely unfamiliar and building meaning from nothing during the data collection encounter itself. This unfamiliarity made the distance between participants' aspirations and their understanding particularly stark: specific and confident ambitions around software development, app redesign, and wealth generation through programming coexisted with no functional grasp of what any of those things would require.

The one participant who came closest to process-level understanding described calculators executing arithmetic through codes, computers operating in binary, and video game button commands producing specific programmed responses because they had been designed to do so. His account moved furthest toward understanding programming as a human-authored logical process rather than an embedded machine property. Yet his interview then placed programming at a social distance, describing it as something meant for those that have intellectuals about computers. That self-exclusion, occurring in the same account that demonstrated the dataset's most developed understanding of programming, suggests that the barrier for this participant was not conceptual but identificatory. He could reason about programming but could not yet imagine himself as someone who does it. Across all participants, the convergence of data reveals that programming was understood almost entirely through its visible outputs, with the underlying logical and creative process remaining opaque.

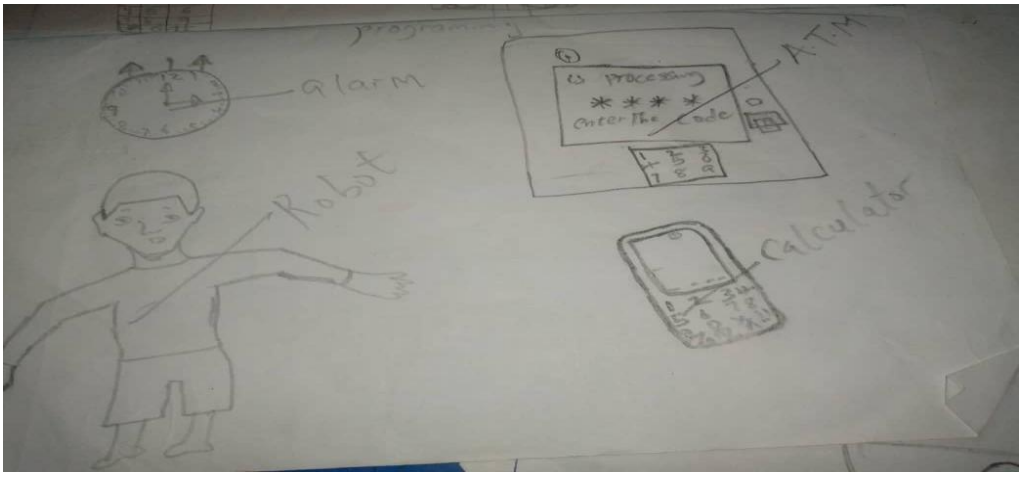


Fig 4 Participant's visual representation of programming

4.3 Theme 2: Computing as a Tool for Economic Survival and Ethical Blindness

Participants' understandings of computing were organised primarily around economic possibility. Across drawings, tell conversations, and interviews, digital tools were consistently framed in terms of what they could produce materially rather than what they could enable educationally or creatively. This economic orientation was not incidental. It reflected the conditions under which participants had encountered computing, observed it in use, and formed aspirations around it. This economic framing was accompanied by a systematic absence of ethical reasoning, and the nature of that absence only became visible when the three data sources were read together.

4.3.1Computing as economic infrastructure.

In their drawings, participants consistently represented computing environments they had observed in their immediate surroundings: Bet9ja betting shops, cybercafes, printing presses, and market-oriented design work. The tell conversations confirmed this, with participants explaining their drawings through the economic uses they had observed, editing, printing, designing, and online transactions. The interview data then revealed the aspirational layer. One participant described seeing a neighbour use CorelDraw to design church flyers and packaging, and connected that observation directly to his own ambition in music production. Another described the internet as transforming his construction apprenticeship, using Instagram to attract clients before losing access to his phone. A third described the internet in terms that captured its economic stakes precisely, "*Without internet, there's no way I can make money. Without internet, you're just like a ghost.*" These accounts position computing not as an educational resource but as an economic

infrastructure, and for participants whose daily lives were organised around informal income generation, that framing was rational and grounded. The drawings and tell conversations show that this economic orientation was formed through observation of specific local computing environments. The interviews confirm that it shaped not only how participants understood computing but what they imagined it could do for them personally.

4.3.2 The Ethical Blindness

What the data also reveals, and what the interview accounts make unavoidable, is that this economic framing extended without apparent hesitation into fraudulent and exploitative digital practices. Participants described spamming, hacking, online blackmail, document falsification, voice cloning for deception, and dating scams in the same register as printing, design, and e-commerce. One participant stated that if he had access to a computer, he would use it for spamming, describing it as something he had been taught and observed others doing successfully. Another described the internet as enabling blackmailing and dating scams, adding "*I hustle there*," with no shift in tone between this and his description of using the internet for information access. A third expressed interest in cybersecurity, stating that computers are important for protecting companies against cyberattack, but framed this alongside an interest in hacking without distinguishing between the two.

In several cases, participants drew images associated with editing, design, and digital production without the DTC data revealing any ethical framing around their intended uses. It was only in the interviews that the nature of those intended uses became explicit. This sequencing indicates the drawings at the surface showed legitimate economic aspiration, and the interviews revealed that the same tools and skills were imagined in contexts of exploitation. Neither source alone would have shown this. Surprisingly, the participants did not present fraud as a necessary evil, a survival compromise, or a transgression they were aware of making. They presented it as a category of skill, equivalent to design or web development, evaluated by its effectiveness rather than its ethics. One participant described spamming as what people do to survive. Another expressed interest in learning hacking from someone who knows how, in the same breath as expressing interest in cybersecurity. A third described wanting to learn voice cloning through AI, describing it as a skill with practical applications. Across these accounts, the distinction between legitimate and exploitative digital practice was not contested or suppressed. It simply did not appear as a relevant category of thought. This ethical silence is not best understood as moral failure. Participants' ethical frameworks around computing were shaped by the same environments

that shaped their conceptual understandings, ones where fraud was a visible and normalised pathway to income. The absence of ethical reasoning was not a gap in their moral lives broadly; it was specific to computing, and it reflected the conditions under which computing had been introduced to them.

4.4 Theme 3: Exposure as a Catalyst for Aspiration

Participants' encounters with computing were almost entirely observational, mediated through watching others use digital tools in specific, recognisable contexts. Observational exposure did not only produce partial conceptual understanding; it also generated a reconfiguration of what participants believed was possible for themselves.

4.4.1 Exposure as the Primary Source of Computing Knowledge

Rather than abstract or generalised depictions of computing, participants drew the specific environments in which they had encountered digital tools: Bet9ja betting shops, cybercafes, printing presses, and market-oriented design contexts. The tell conversations confirmed that these drawings were reproductions of observed scenes rather than imaginative reconstructions, with participants explaining their choices by narrating what they had seen others do rather than what they themselves had done. One participant described computers being used to print documents, explaining his drawing by recounting watching someone at a printing machine and keyboard. Another drew a Spectranet device because he had seen one used to provide internet in his immediate environment. What this pattern establishes, and what distinguishes it from the fragmented conceptual understandings documented in Theme 1, is the mechanism behind those understandings. Observation without participation produced recognition of artefacts and contexts without any grasp of the principles operating within them. The participant who drew a printing machine as his primary computing reference could identify the context but not explain what the computer was doing within it.

4.4.2 The Aspirational Leap

Witnessing computing in use within a recognisable context produced a specific and identifiable shift across accounts. From seeing what technology could do to imagining what it could do for oneself. This shift was anchored in specific observed moments that became templates for imagined futures. Watching someone edit photos, create passports, and manipulate images produced the statement: *"I really like what he's doing with his computer. That's why I came here so that I can also learn.*" Watching a neighbour use CorelDraw to

design church flyers and packaging became the basis for imagining a future in music production and audio editing. Similarly, documenting construction work on Instagram and receiving client enquiries in response demonstrated, through direct experience, that the internet could function as economic infrastructure for someone in that position, shaping not only functional understanding but a sense of what could be built with it, before access was lost. Exposure, in these accounts, was not merely informational. It generated aspiration by converting observed practice into imagined possibilities within the computing space that participants had not previously considered accessible to them.

Observational exposure also revealed its limits. The same mechanism that generated aspiration could not provide the conceptual foundation needed to act on it. Aspirations were specific and confident: developing a software platform (Apollo ai), designing a website, building an e-commerce presence. Yet in each case the aspiration existed entirely independently of any understanding of what achieving it would involve. What participants had seen had activated their perception and imagination of what computing could offer them, but left the route entirely absent, producing a gap between desire and capacity that observation alone could not close.

4.4.3 The Social Conditions of the Aspirational Leap

Across these accounts, the aspirational leap followed a consistent structure. Computing was observed being used by someone in a context that felt recognisable and relatable a peer, a neighbour, a community member, rather than an institutional authority or formal instructor. That proximity and relatability was what made the imagined future feel accessible rather than abstract. The accounts did not describe watching professionals use computers in offices or formal classroom encounters; they described watching people in their immediate social worlds do something compelling. The transformative potential of exposure was not simply a function of seeing computing, but of seeing computing performed by someone whose social position made it imaginable as something available to oneself. For street-connected youth, the imagination of a computing future was not sparked by technology alone but by seeing someone like themselves engage with it.

5.0 Discussion

This study explored how street-connected youth in an urban Nigerian context construct meanings around four foundational computing concepts: the computer, the internet,

programming, and artificial intelligence. Three themes emerged from the analysis. The first revealed fragmented understandings across all four computing domains, with participants demonstrating surface-level recognition without conceptual grasp of underlying principles. The second showed that computing was framed primarily as a tool for economic survival, accompanied by a systematic absence of ethical reasoning. The third established that observational exposure, rather than formal instruction, was the primary mechanism through which computing knowledge and aspiration were formed. Each theme is discussed in turn in relation to existing literature and its implications for broadening participation in computing

The first theme, fragmented understandings of foundational computing concepts, situates the findings within a broader pattern documented across the youth computing perception literature while revealing its more acute expression among populations with limited or disrupted access to formal computing education. The pattern of recognition without comprehension closely mirrors findings reported by Oyedoyin et al. (2025) among children in an African out-of-school educational setting, one of the few studies to examine computing perceptions among educationally marginalised youth in similar contextual conditions. In that study, computers were recognised as familiar physical artefacts, yet their underlying functions remained poorly understood. The present study extends this evidence to street-connected adolescents and young adults whose educational trajectories have experienced more prolonged disruption, suggesting that such fragmented understandings may persist beyond early childhood in contexts where structured computing learning is absent. This pattern also reflects what Rücker and Pinkwart (2016) describe as perception-to-function errors, whereby the visible characteristics of technological components become the basis for inferring their purpose.

Importantly, fragmentation was not distributed evenly across concepts. Artificial intelligence emerged as the most coherent area of understanding, with participants frequently associating it with automation, task efficiency, and intelligent technological assistance. This pattern aligns with studies suggesting that individuals often encounter AI through highly visible applications before developing formal conceptual knowledge of the technology itself (Chang et al., 2026; Kasinidou et al., 2024). By contrast, programming remained largely unfamiliar. Participants frequently interpreted programmed behaviour as an inherent property of machines rather than the outcome of human-authored instructions, reflecting observations by Oyedoyin et al. (2025). The contrast between AI and programming

suggests that conceptual accessibility is shaped by the visibility of technologies within everyday life. Technologies embedded in commonly used applications may provide observational learners with reference points for constructing meaning, whereas concepts such as programming remain largely inaccessible because the processes involved are concealed behind user interfaces. Consequently, informal exposure may facilitate recognition of technological outcomes without necessarily fostering understanding of the systems that produce them.

These findings can be interpreted through a social constructivist lens, which posits that knowledge develops through interaction with socially and culturally mediated experiences. Participants' understandings appeared to emerge from repeated encounters with the practical functions of technology within their daily environments rather than from formal instruction or guided exploration of computational systems. As a result, knowledge was constructed around what technologies accomplish rather than how they operate. The findings therefore support arguments that conceptual learning is shaped by the nature of participation itself. Engagement that is primarily functional may enable individuals to navigate technologies effectively while leaving underlying computational principles largely unexplored.

The findings further challenge assumptions that digital participation naturally produces computing literacy. Existing research consistently demonstrates that marginalised and street-involved populations use digital technologies extensively to maintain social relationships, access information, seek economic opportunities, and manage everyday life (Le Dantec, 2008; Mitchell & Selfridge, 2017; Selfridge, 2016; Wang, 2025). Participants in the present study reflected this pattern. Many described using smartphones and internet-based platforms to support income generation, communication, and social connection. Nevertheless, several struggled to identify smartphones as computers or to distinguish the internet from broader forms of technological connectivity. These findings suggest that frequent technology use and conceptual understanding represent related but distinct dimensions of digital engagement. Rather than emerging automatically through use, computing knowledge may require opportunities for reflection, explanation, and guided learning that are often absent in contexts characterised by educational disruption and socioeconomic precarity.

Importantly, the findings should not be interpreted through a deficit perspective. Although participants demonstrated limited understanding of formal computing concepts, they displayed considerable competence in using digital technologies to navigate complex social and economic realities. Their engagement with technology reflected forms of practical and adaptive digital expertise developed in response to everyday needs rather than educational objectives. This distinction is significant because it challenges binary assumptions that individuals are either digitally literate or digitally excluded. Participants occupied a more nuanced position. They were active digital users who possessed substantial functional competencies but limited access to the conceptual knowledge typically associated with computing education. Recognising this distinction has important implications for broadening participation in computing. Educational interventions may be more effective when they build upon existing digital practices and experiences rather than assuming a complete absence of technological knowledge. By connecting foundational computing concepts to technologies that participants already use and understand, programmes may be better positioned to bridge the gap between functional engagement and conceptual understanding.

A central pattern emerging from Theme 2 is the framing of computing as a tool for economic survival, alongside a consistent absence of ethical reasoning in accounts of digital practice. Participants consistently oriented their understanding of computing toward income generation and material gain, describing digital tools in terms of what they could achieve economically rather than what they could learn or create. This pattern resonates with prior evidence that street-connected and homeless youth appropriate digital technologies instrumentally, using whatever access is available as a resource for survival and self-sustenance (Le Dantec, 2008; Selfridge, 2016). However, the present findings extend this evidence in a direction the existing literature has not fully documented. Unlike the digital advocacy and community-building documented in prior study participants in this study described a digital landscape in which fraud, hacking, document falsification, and online deception were referenced with the same practical matter-of-factness as printing, design, and business use, without moral framing, ethical hesitation, or apparent concern for consequence (Bhandari & Sun, 2023; Johnson et al., 2019). This ethical dimension was not visible within any single data source. While the drawings conveyed surface-level economic aspiration, it was only through triangulation with interview data that the underlying practices became explicit, revealing a divergence across methods that would otherwise have remained obscured.

From a social constructivist perspective, this absence of ethical differentiation is explicable through the situated construction of meaning within participants' lived environments. Participants constructed their understandings of computing through the cultural tools, social practices, and environmental conditions available to them (Lave & Wenger, 1991; Vygotsky, 1978). In contexts where survival is precarious and formal ethical instruction is absent, the meanings attached to digital tools are shaped by what those tools are seen to do in the immediate social world. The implication is not that these youth lack ethical capacity broadly, but that computing education has not yet reached them in ways that cultivate it specifically. This finding also complicates the asset-based framing that has emerged within the street youth literature (Gabriel, 2026; L. R. Johnson et al., 2019). Assets are clearly present, curiosity, ambition, practical intelligence, and genuine digital engagement are all evident in participants' accounts. But those assets are currently being channelled through frameworks of meaning that computing education, were it to engage this population seriously, would need to both understand and thoughtfully complicate.

The third theme, exposure as a catalyst for aspiration, is the most theoretically grounded of the three and the most directly anticipated by the social constructivist framework informing this study. Participants' understandings of computing were formed not through formal instruction but through observation of others using digital tools in their immediate environments: witnessing photo editing, encountering POS machines and modems, seeing digital design used in small commercial operations, hearing about hacking from peers. This pattern of observational learning as the primary mechanism through which computing meaning is constructed is precisely what Vygotsky's (1978) sociocultural theory would predict in the absence of formal instructional mediation, and it directly replicates the finding of Oyedoyin et al. (2025) that the ideas young African learners held about computing emerged primarily from observation of adults and media rather than from any educational encounter. The present findings, however, reveal two dimensions that the existing literature has not fully captured. The first is the social specificity of the aspirational leap. Participants did not describe aspiration arising from abstract awareness of computing's possibilities. They described it arising from watching specific people in recognisable social positions use digital tools in contexts they could relate to, a neighbour, a peer, a community member.

That social proximity was what made the imagined future feel available rather than remote, connecting to Hardwick, (2017) documentation of how street-involved youth use digital

media to imagine and assert new identities, and to Johnson et al. (2019) finding that street-connected adolescents demonstrate meaningful developmental assets including commitment to learning. The second dimension, and the one with the most direct implication for computing education, is the ceiling of what observational exposure alone can achieve. Several participants expressed confident and specific aspirations, developing software, designing websites, building e-commerce platforms, that rested on no technical understanding whatsoever. The aspiration was genuine; the conceptual scaffolding was entirely absent. This finding reframes what computing education would need to do for this population. Interest and motivation are not the problem; the data suggests both are already present, formed through the same observational encounters that produced fragmented conceptual understanding. What computing education needs to provide is the structured pathway between an existing aspirational orientation and the technical and conceptual knowledge required to act on it. That pathway is what observational exposure, however transformative affectively, cannot supply.

5.1 Unique Contribution

This study extends BPC scholarship in three ways. It establishes street-connected youth as a legitimate computing education population, one entirely absents from existing BPC research and intervention frameworks. It demonstrates that aspiration and digital engagement are already present in this population, formed through observational exposure, requiring structured pathways rather than motivational groundwork. And it surfaces ethical orientation as a non-negotiable dimension of computing literacy for populations whose digital encounters have been shaped by environments where exploitative practices are normalised. These contributions call on the field to expand not only who has access to computing education but who it recognises as a computing learner in the first place.

5.2 Limitations

While this study provides an understanding into this population computing perception, street-connected youth are a heterogeneous and their experiences vary considerably across urban and rural settings, national contexts, gender, age, and degree of street involvement dimensions that a single-site study cannot capture. Likewise, the exclusively male composition of the sample reflects a recruitment limitation rather than a deliberate design choice. Future research should engage larger and more diverse samples across multiple sites and national contexts, including female and younger street-connected youth,

whose computing perceptions and experiences may differ significantly from those documented here.

5.3 Recommendations

The findings carry practical implications for both implementation and future research. For practitioners designing computing education programmes with street-connected youth, instruction should begin from participants' existing aspirational orientations rather than assuming motivation needs to be created. Curriculum should sequence concept introduction from the familiar toward the unfamiliar, building on participants' existing familiarity with AI applications as an entry point into computational thinking and programming logic. Given that participants' first encounters with computing occurred in environments where exploitative digital practices were normalised without ethical framing, any computing education effort extended to this population should embed digital ethics as a foundational and applied component of instruction rather than a peripheral addition. Participants need to encounter ethical reasoning as integral to computing practice, grounded in scenarios and consequences that are recognisable within their own social contexts, so that its relevance is felt rather than merely stated.

For researchers, future studies should extend this work to female street-connected youth, whose experiences and perceptions remain entirely unexamined, and to rural and peri-urban contexts where patterns of digital exposure may differ considerably from the urban setting studied here. Given that web development emerged both as a stated interest in participants' demographic profiles and as a recurring aspiration in their accounts, future research should explore the feasibility and impact of introducing street-connected youth to foundational web development as an entry point into computing education. Such a study would provide evidence on whether aspirationally grounded instruction, beginning from what participants already want to build, produces stronger conceptual engagement than curricula designed without reference to learner-identified goals. Participatory and visual methods remain appropriate for this population, but piloting with the target group prior to full data collection would strengthen data completeness and reduce method-related attrition.

5.5 Conclusion

This study set out to examine how street-connected youth in an urban Nigerian context understand and make sense of foundational computing concepts. The findings reveal a population that is neither digitally absent nor disinterested, but one whose relationship with

computing has been shaped entirely by the conditions of street life: observational rather than instructional, survival-oriented rather than exploratory, and aspirational without the conceptual foundation to act on that aspiration. Their absence from computing education scholarship, as this study has argued, is not incidental. It mirrors the structural invisibility that defines their exclusion from formal institutions more broadly. What the study contributes is an empirical account of what computing means to this population on their own terms, before formal instruction intervenes. That account is necessary for any computing education effort that seeks to engage street-connected youth seriously rather than impose pre-designed curricula onto unarticulated assumptions about who these young people are and what they already know. The findings suggest that the conditions for meaningful computing engagement exist: curiosity is present, aspiration is present, and functional digital experience is present. What is absent is the structured pathway that connects those conditions to computing knowledge and participation, and the ethical orientation that ensures that pathway leads toward empowerment rather than exploitation. Broadening participation in computing to include street-connected youth is not only a technical or logistical challenge. It is an epistemic one, requiring the field to recognise this population as legitimate computing learners whose experiences, however distant from formal instruction, constitute a foundation worth building on.

Declarations

Ethical approval

Ethics approval was not required for this study. In accordance with the National Code of Health Research Ethics (NCHRE) of Nigeria (National Health Research Ethics Committee of Nigeria, 2007, Section B(d) and (e)), programme-evaluation and service-quality studies that do not involve randomisation are exempt from Health Research Ethics Committee (HREC) oversight. The study constituted operational research conducted by the first author in his capacity as Chief Learning Officer of School In The Street (SITS) to evaluate and enhance existing educational and vocational services regularly delivered by the organisation to street-connected youth. Permission to conduct the study was obtained from SITS, which served as the research site. All procedures were performed in accordance with the ethical standards of the Declaration of Helsinki (1964) and its later amendments, and with the principles for the responsible conduct of research of the Finnish National Board on Research Integrity (TENK).

Consent to participate

Participation in the study was entirely voluntary. The participant information accompanying the study invitation explained the purpose of the research and informed participants that, upon providing consent to participate, they would take part in the study with the understanding that their personal information would be handled in a strictly confidential manner. Written informed consent was obtained from all participants before data collection. Participants were also informed of their right to decline participation or withdraw from the study at any time without consequence. As the study involved street-connected young people living independently, including some participants under the age of 16 years, parental or legal guardian consent was not practicable.

Consent to publish

Not applicable. This manuscript does not contain any identifiable individual data.

Competing interests

The first author is employed by School In The Street (SITS), the non-governmental organisation where this study was conducted. The remaining authors declare that they have no competing interests (financial or non-financial).

Funding

No funding was received for conducting this study.

Data Availability

The datasets generated and/or analysed during the current study are available in the Open Science Framework (OSF) repository at https://doi.org/10.17605/OSF.IO/DQ4NT.

Author Contributions

I. S. conceived the study, designed the research methodology and data collection instrument, and provided overall scientific supervision. T. L. coordinated data collection and analysed the data, and drafted the manuscript. S. O. and T. O. reviewed the manuscript and contributed to its restructuring and improvement. All authors read and approved the final manuscript.

Acknowledgements

The authors sincerely thank Mrs Julia Idowu, Learning Officer at SITS, for her invaluable assistance with participant coordination throughout the study. We extend our appreciation to Mr Olakunle Sanni, Executive Director of SITS, for granting permission to conduct this research at the organisation's mobile centre.

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