



RESEARCH ARTICLE

Digital Inequality and Educational Opportunity Among Students in Emerging Economies

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ABSTRACT

Digital transformation is widening access to higher education while also exposing persistent differences in how students participate, learn and benefit from digital environments. This conceptual article examines digital inequality among students in emerging economies through a multilevel opportunity perspective that integrates material access, affordability, connectivity, digital and AI literacy, academic technology use, digital capital and educational outcomes. The analysis shows that disadvantage accumulates when unstable infrastructure, limited capability and unequal social resources restrict students' ability to convert technological provision into meaningful academic value. Five structural pressures are examined: affordability and device constraints, uneven advanced literacies, intersecting socioeconomic disadvantages, platform-dependent learning conditions and limited institutional capacity. The article then develops five strategic responses centred on resilient access ecosystems, curriculum-embedded capability development, targeted inclusion, low-friction learning design and outcome-based digital equity governance. Its principal contribution is to reposition digital inclusion as an educational opportunity system rather than a technology-provision exercise. Effective equity therefore depends on whether students can sustain participation, exercise academic agency, progress through learning requirements and obtain comparable benefits from increasingly digital higher education.

Keywords: Inequality, Opportunity, Access, Literacy, Equity

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1. INTRODUCTION

Digital access has become an academic prerequisite instead of remaining a discretionary convenience in technology-intensive higher education. Within emerging-economy university environments, material access develops through uneven infrastructure, household resources, institutional capability and the growing expectation that students will manage essential academic activity through digital systems. The central equity concern asks whether students can enter virtual classrooms, retrieve readings, submit assessments and communicate with lecturers without recurrent disruption. Research across university contexts demonstrates that device quality, data affordability and connection stability can turn formally universal digital provision into materially unequal learning conditions (Adarkwah, 2021; Subramaniam et al., 2024). This separation matters analytically because formal access to a platform does not ensure meaningful participation, and participation does not necessarily yield comparable educational opportunity. Better-resourced learners can compensate for digital disruption by purchasing data, replacing devices, seeking private assistance or changing study locations, while resource-constrained learners possess fewer ways to compensate. Digital inequality thus emerges through differential conversion, where similar technologies produce different academic possibilities depending on the resources surrounding each learner. Universities must therefore evaluate both technological availability and the conditions that allow students to use digital resources consistently, confidently and with academic purpose. An effective digital equity agenda must connect material access with curriculum design, academic support and measurable student outcomes instead of treating it as an isolated information technology responsibility.

Comparative evidence indicates that digital capital must be interpreted together with the institutional and social conditions surrounding students. Within higher education in emerging economies, digital capital develops through uneven infrastructure, household resources, institutional capability and the growing expectation that students will manage essential academic activity through digital systems. The key distributional question is whether students can combine devices, skills, networks and institutional knowledge to secure academic benefits. Studies across tertiary environments show that family income, cultural resources and social networks can turn formally universal digital provision into materially unequal learning conditions (Clamor & Saloma, 2023; Devisakti et al., 2024). This difference deserves attention because formal access to a platform does not ensure meaningful participation, and participation does not necessarily yield comparable opportunity conversion. Students with greater financial, social and technological resources can often buffer disruption through purchasing data, replacing devices, seeking private assistance or changing study locations, while resource-constrained learners possess fewer ways to compensate. Accordingly, digital inequality operates as an unequal conversion process in which similar technologies produce different academic possibilities depending on the resources surrounding each learner. Universities should assess access together with the practical conditions that determine whether digital tools can be used repeatedly, effectively and purposefully. A robust institutional equity approach needs to connect digital capital with curriculum design, academic support and measurable student outcomes instead of treating it as an isolated information technology responsibility.

The meaning of digital literacy now extends beyond basic operational competence as learning environments become more data-intensive and AI-assisted. In rapidly digitalising emerging economies, digital capability develops through uneven infrastructure, household resources,

institutional capability and the growing expectation that students will manage essential academic activity through digital systems. The main equity test is whether students can search critically, evaluate information, protect privacy, create academic content and use intelligent tools responsibly. Evidence from higher education settings indicates that uneven prior exposure, language and confidence can turn formally universal digital provision into materially unequal learning conditions (Barra et al., 2024; Michikyan et al., 2025). The difference has practical significance because formal access to a platform does not ensure meaningful participation, and participation does not necessarily yield comparable learning agency. Students possessing broader financial, relational and technological resources can respond to disruption through purchasing data, replacing devices, seeking private assistance or changing study locations, while resource-constrained learners possess fewer ways to compensate. This pattern positions digital inequality as a conversion problem whereby similar technologies produce different academic possibilities depending on the resources surrounding each learner. Higher education providers need to judge digital access by the reliability, confidence and academic purpose that students can sustain over time. A credible digital opportunity strategy should therefore link digital capability with curriculum design, academic support and measurable student outcomes instead of treating it as an isolated information technology responsibility.

The relationship becomes particularly important when intersecting inequality is deeply conditioned by institutional arrangements and students' wider social circumstances. Across emerging-economy higher education systems, intersecting inequality develops through uneven infrastructure, household resources, institutional capability and the growing expectation that students will manage essential academic activity through digital systems. A decisive equity issue concerns whether students can access comparable opportunities regardless of household resources or place of residence. Comparative higher education evidence suggests that rural infrastructure gaps, gendered norms and household constraints can turn formally universal digital provision into materially unequal learning conditions (Katz et al., 2021; Katz et al., 2025). The distinction carries educational consequences because formal access to a platform does not ensure meaningful participation, and participation does not necessarily yield comparable equity. Students with stronger resource portfolios can reduce disruption through purchasing data, replacing devices, seeking private assistance or changing study locations, while resource-constrained learners possess fewer ways to compensate. Digital inequality is therefore better understood as a differential conversion process whereby similar technologies produce different academic possibilities depending on the resources surrounding each learner. Institutional evaluation should move beyond availability and examine whether students can use digital systems reliably, confidently and in ways that support learning. A meaningful educational opportunity strategy should integrate intersecting inequality with curriculum design, academic support and measurable student outcomes instead of treating it as an isolated information technology responsibility.

A third-level digital-divide perspective directs attention to who obtains measurable educational benefits after access and skills have been considered. Across resource-diverse emerging economies, digital outcomes develops through uneven infrastructure, household resources, institutional capability and the growing expectation that students will manage essential academic activity through digital systems. A fundamental opportunity question is whether students can translate digital participation into achievement, persistence, belonging, employability and further study. Available

university evidence indicates that cumulative disadvantage across earlier levels of the divide can turn formally universal digital provision into materially unequal learning conditions (Passey et al., 2024; Qin et al., 2024). This distinction is important because formal access to a platform does not ensure meaningful participation, and participation does not necessarily yield comparable educational outcomes. Learners with stronger economic, social and digital resources can usually manage disruption by purchasing data, replacing devices, seeking private assistance or changing study locations, while resource-constrained learners possess fewer ways to compensate. Digital inequality consequently reflects unequal conversion, meaning that similar technologies produce different academic possibilities depending on the resources surrounding each learner. Institutional scrutiny must consider not just provision, but whether students can sustain confident and purposeful digital participation across normal academic routines. A sustainable digital opportunity framework should align digital outcomes with curriculum design, academic support and measurable student outcomes instead of treating it as an isolated information technology responsibility.

2.0 DIGITAL INEQUALITY FOUNDATIONS SHAPING EDUCATIONAL OPPORTUNITY DISTRIBUTION

Contemporary digital inequality in higher education is no longer adequately explained by a simple distinction between students who are connected and those who are not. Educational opportunity increasingly depends on the quality of devices; affordability and stability of connectivity, digital and AI literacies, patterns of academic use, and the capacity to convert technology into meaningful learning outcomes. Research on first; second and third levels of the digital divide shows that inequalities can persist even where basic internet access expands (Scheerder et al., 2017; van Deursen & van Dijk, 2019). Across resource-diverse emerging economies, these layers interact with income, geography, gender, institutional resources and uneven digital infrastructure. The five foundations developed below therefore position digital inequality as a cumulative educational process linking material access; capability, engagement, digital capital and outcomes rather than as a single technology deficit.

2.1 Material Infrastructure Access Shaping Student Digital Participation

Within material infrastructure access shaping student digital participation, digital access has become an academic prerequisite instead of remaining a discretionary convenience in technology-intensive higher education. In rapidly digitalising emerging economies, material access develops through uneven infrastructure, household resources, institutional capability and the growing expectation that students will manage essential academic activity through digital systems. The main equity test is whether students can enter virtual classrooms, retrieve readings, submit assessments and communicate with lecturers without recurrent disruption. Evidence from higher education settings indicates that device quality, data affordability and connection stability can turn formally universal digital provision into materially unequal learning conditions (Abd Wahab & Yusof, 2020; Ghani et al., 2025). The difference has practical significance because formal access to a platform does not ensure meaningful participation, and participation does not necessarily yield comparable educational opportunity. Within material infrastructure access shaping student digital participation, students possessing broader financial, relational and technological resources can respond to disruption through purchasing data, replacing devices, seeking private assistance or changing study locations, while resource-constrained learners possess fewer ways to compensate. Within material infrastructure access shaping student digital participation, this pattern positions digital inequality as

a conversion problem whereby similar technologies produce different academic possibilities depending on the resources surrounding each learner. Within material infrastructure access shaping student digital participation, higher education providers need to judge digital access by the reliability, confidence and academic purpose that students can sustain over time. A credible digital opportunity strategy should therefore link material access with curriculum design, academic support and measurable student outcomes instead of treating it as an isolated information technology responsibility.

Comparative evidence indicates that material access is deeply conditioned by institutional arrangements and students' wider social circumstances. Across emerging-economy higher education systems, material access develops through uneven infrastructure, household resources, institutional capability and the growing expectation that students will manage essential academic activity through digital systems. A decisive equity issue concerns whether students can enter virtual classrooms, retrieve readings, submit assessments and communicate with lecturers without recurrent disruption. Comparative higher education evidence suggests that device quality, data affordability and connection stability can turn formally universal digital provision into materially unequal learning conditions (Zaini et al., 2026). The distinction carries educational consequences because formal access to a platform does not ensure meaningful participation, and participation does not necessarily yield comparable educational opportunity. Within material infrastructure access shaping student digital participation, students with stronger resource portfolios can reduce disruption through purchasing data, replacing devices, seeking private assistance or changing study locations, while resource-constrained learners possess fewer ways to compensate. Within material infrastructure access shaping student digital participation, digital inequality is therefore better understood as a differential conversion process whereby similar technologies produce different academic possibilities depending on the resources surrounding each learner. Within material infrastructure access shaping student digital participation, institutional evaluation should move beyond availability and examine whether students can use digital systems reliably, confidently and in ways that support learning. A meaningful educational opportunity strategy should integrate material access with curriculum design, academic support and measurable student outcomes instead of treating it as an isolated information technology responsibility.

2.2 Digital Literacy Capabilities Strengthening Student Learning Agency

Within digital literacy capabilities strengthening student learning agency, the meaning of digital literacy now extends beyond basic operational competence as learning environments become more data-intensive and AI-assisted. Within digital literacy capabilities strengthening student learning agency, in rapidly digitalising emerging economies, digital capability develops through uneven infrastructure, household resources, institutional capability and the growing expectation that students will manage essential academic activity through digital systems. Within digital literacy capabilities strengthening student learning agency, the main equity test is whether students can search critically, evaluate information, protect privacy, create academic content and use intelligent tools responsibly. Evidence from higher education settings indicates that uneven prior exposure, language and confidence can turn formally universal digital provision into materially unequal learning conditions (Yusof, Razak, Jamaludin, et al., 2025). Within digital literacy capabilities strengthening student learning agency, the difference has practical significance because formal access to a platform does not ensure meaningful participation, and participation does not necessarily yield comparable

learning agency. Within digital literacy capabilities strengthening student learning agency, students possessing broader financial, relational and technological resources can respond to disruption through purchasing data, replacing devices, seeking private assistance or changing study locations, while resource-constrained learners possess fewer ways to compensate. Within digital literacy capabilities strengthening student learning agency, this pattern positions digital inequality as a conversion problem whereby similar technologies produce different academic possibilities depending on the resources surrounding each learner. Within digital literacy capabilities strengthening student learning agency, higher education providers need to judge digital access by the reliability, confidence and academic purpose that students can sustain over time. Within digital literacy capabilities strengthening student learning agency, a credible digital opportunity strategy should therefore link digital capability with curriculum design, academic support and measurable student outcomes instead of treating it as an isolated information technology responsibility.

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2.3 Academic Technology Use Shaping Student Engagement Quality

Patterns of academic technology use matter because access alone does not determine whether digital resources are converted into productive academic engagement. In rapidly digitalising emerging economies, academic use develops through uneven infrastructure, household resources, institutional capability and the growing expectation that students will manage essential academic activity through digital systems. The main equity test is whether students can organise learning, collaborate, seek feedback and select tools that fit the intellectual demands of a task. Evidence from higher education settings indicates that entertainment-oriented use, platform complexity and weak guidance can turn formally universal digital provision into materially unequal learning conditions (Yusof, Salleh, &

Zahari, 2020). The difference has practical significance because formal access to a platform does not ensure meaningful participation, and participation does not necessarily yield comparable engagement quality. Within academic technology use shaping student engagement quality, students possessing broader financial, relational and technological resources can respond to disruption through purchasing data, replacing devices, seeking private assistance or changing study locations, while resource-constrained learners possess fewer ways to compensate. Within academic technology use shaping student engagement quality, this pattern positions digital inequality as a conversion problem whereby similar technologies produce different academic possibilities depending on the resources surrounding each learner. Within academic technology use shaping student engagement quality, higher education providers need to judge digital access by the reliability, confidence and academic purpose that students can sustain over time. Importantly, institutional monitoring should also test whether academic use gaps narrow across different student groups over time.

Closer analysis demonstrates that academic use is deeply conditioned by institutional arrangements and students' wider social circumstances. Across emerging-economy higher education systems, academic use develops through uneven infrastructure, household resources, institutional capability and the growing expectation that students will manage essential academic activity through digital systems. A decisive equity issue concerns whether students can organise learning, collaborate, seek feedback and select tools that fit the intellectual demands of a task. Comparative higher education evidence suggests that entertainment-oriented use, platform complexity and weak guidance can turn formally universal digital provision into materially unequal learning conditions (Yusof & Abd Wahab, 2021). The distinction carries educational consequences because formal access to a platform does not ensure meaningful participation, and participation does not necessarily yield comparable engagement quality. Within academic technology use shaping student engagement quality, students with stronger resource portfolios can reduce disruption through purchasing data, replacing devices, seeking private assistance or changing study locations, while resource-constrained learners possess fewer ways to compensate. Within academic technology use shaping student engagement quality, digital inequality is therefore better understood as a differential conversion process whereby similar technologies produce different academic possibilities depending on the resources surrounding each learner. Within academic technology use shaping student engagement quality, institutional evaluation should move beyond availability and examine whether students can use digital systems reliably, confidently and in ways that support learning. A meaningful educational opportunity strategy should integrate academic use with curriculum design, academic support and measurable student outcomes instead of treating it as an isolated information technology responsibility.

2.4 Digital Capital Positioning Student Educational Opportunity Conversion

Contemporary digital capital provides a useful bridge between technological resources and the wider social advantages that shape educational trajectories. In rapidly digitalising emerging economies, digital capital develops through uneven infrastructure, household resources, institutional capability and the growing expectation that students will manage essential academic activity through digital systems. The main equity test is whether students can combine devices, skills, networks and institutional knowledge to secure academic benefits. Evidence from higher education settings indicates that family income, cultural resources and social networks can turn formally universal digital provision into materially unequal learning conditions (Lybeck et al., 2024; Ragnedda, 2018). The difference has practical significance because formal access to a platform does not ensure

meaningful participation, and participation does not necessarily yield comparable opportunity conversion. Within digital capital positioning student educational opportunity conversion, students possessing broader financial, relational and technological resources can respond to disruption through purchasing data, replacing devices, seeking private assistance or changing study locations, while resource-constrained learners possess fewer ways to compensate. Within digital capital positioning student educational opportunity conversion, this pattern positions digital inequality as a conversion problem whereby similar technologies produce different academic possibilities depending on the resources surrounding each learner. Within digital capital positioning student educational opportunity conversion, higher education providers need to judge digital access by the reliability, confidence and academic purpose that students can sustain over time. A credible digital opportunity strategy should therefore link digital capital with curriculum design, academic support and measurable student outcomes instead of treating it as an isolated information technology responsibility.

Its strategic importance becomes clearer when digital capital is deeply conditioned by institutional arrangements and students' wider social circumstances. Across emerging-economy higher education systems, digital capital develops through uneven infrastructure, household resources, institutional capability and the growing expectation that students will manage essential academic activity through digital systems. A decisive equity issue concerns whether students can combine devices, skills, networks and institutional knowledge to secure academic benefits. Comparative higher education evidence suggests that family income, cultural resources and social networks can turn formally universal digital provision into materially unequal learning conditions (Hargittai, 2002; Helsper, 2012). The distinction carries educational consequences because formal access to a platform does not ensure meaningful participation, and participation does not necessarily yield comparable opportunity conversion. Within digital capital positioning student educational opportunity conversion, students with stronger resource portfolios can reduce disruption through purchasing data, replacing devices, seeking private assistance or changing study locations, while resource-constrained learners possess fewer ways to compensate. Within digital capital positioning student educational opportunity conversion, digital inequality is therefore better understood as a differential conversion process whereby similar technologies produce different academic possibilities depending on the resources surrounding each learner. Within digital capital positioning student educational opportunity conversion, institutional evaluation should move beyond availability and examine whether students can use digital systems reliably, confidently and in ways that support learning. A meaningful educational opportunity strategy should integrate digital capital with curriculum design, academic support and measurable student outcomes instead of treating it as an isolated information technology responsibility.

2.5 Digital Divide Outcomes Influencing Student Educational Progression

Within digital divide outcomes influencing student educational progression, a third-level digital-divide perspective directs attention to who obtains measurable educational benefits after access and skills have been considered. In rapidly digitalising emerging economies, digital outcomes develops through uneven infrastructure, household resources, institutional capability and the growing expectation that students will manage essential academic activity through digital systems. The main equity test is whether students can translate digital participation into achievement, persistence, belonging, employability and further study. Evidence from higher education settings indicates that

cumulative disadvantage across earlier levels of the divide can turn formally universal digital provision into materially unequal learning conditions (Gulzar et al., 2024; Madhubhashini, 2022). The difference has practical significance because formal access to a platform does not ensure meaningful participation, and participation does not necessarily yield comparable educational outcomes. Within digital divide outcomes influencing student educational progression, students possessing broader financial, relational and technological resources can respond to disruption through purchasing data, replacing devices, seeking private assistance or changing study locations, while resource-constrained learners possess fewer ways to compensate. Within digital divide outcomes influencing student educational progression, this pattern positions digital inequality as a conversion problem whereby similar technologies produce different academic possibilities depending on the resources surrounding each learner. Within digital divide outcomes influencing student educational progression, higher education providers need to judge digital access by the reliability, confidence and academic purpose that students can sustain over time. A credible digital opportunity strategy should therefore link digital outcomes with curriculum design, academic support and measurable student outcomes instead of treating it as an isolated information technology responsibility.

An outcome-focused interpretation demonstrates that digital outcomes are deeply conditioned by institutional arrangements and students' wider social circumstances. Across emerging-economy higher education systems, digital outcomes develops through uneven infrastructure, household resources, institutional capability and the growing expectation that students will manage essential academic activity through digital systems. A decisive equity issue concerns whether students can translate digital participation into achievement, persistence, belonging, employability and further study. Comparative higher education evidence suggests that cumulative disadvantage across earlier levels of the divide can turn formally universal digital provision into materially unequal learning conditions (Hong et al., 2024; Zhang et al., 2026). The distinction carries educational consequences because formal access to a platform does not ensure meaningful participation, and participation does not necessarily yield comparable educational outcomes. Within digital divide outcomes influencing student educational progression, students with stronger resource portfolios can reduce disruption through purchasing data, replacing devices, seeking private assistance or changing study locations, while resource-constrained learners possess fewer ways to compensate. Within digital divide outcomes influencing student educational progression, digital inequality is therefore better understood as a differential conversion process whereby similar technologies produce different academic possibilities depending on the resources surrounding each learner. Within digital divide outcomes influencing student educational progression, institutional evaluation should move beyond availability and examine whether students can use digital systems reliably, confidently and in ways that support learning. A meaningful educational opportunity strategy should integrate digital outcomes with curriculum design, academic support and measurable student outcomes instead of treating it as an isolated information technology responsibility.

3.0 STRUCTURAL DIGITAL PRESSURES REPRODUCING EDUCATIONAL OPPORTUNITY DISPARITIES

The expansion of digitally mediated higher education has opened new routes into learning while also exposing structural pressures that distribute those opportunities unevenly. Students may possess a smartphone yet remain disadvantaged by data costs; unstable networks, shared devices, limited

digital skills or platforms designed around assumptions of continuous broadband access. Evidence from Malaysia; Ghana, Pakistan and the Philippines illustrates how socioeconomic position, place and institutional capacity shape digital participation in distinct but connected ways (Adarkwah, 2021; Barra et al., 2024; Clamor & Saloma, 2023; Subramaniam et al., 2024). Importantly, the challenges considered in this section are therefore not isolated technical problems. They are mechanisms through which existing social inequalities can be translated into differences in attendance; engagement, assessment performance, belonging and progression. Understanding these pressures remains necessary before digital inclusion can be treated as an educational opportunity strategy.

3.1 Affordability Connectivity Device Constraints Limiting Student Participation

Affordability continues to represent a structural constraint because connectivity is meaningful only when students can sustain its recurring costs throughout a semester. Within higher education in emerging economies, affordable connectivity develops through uneven infrastructure, household resources, institutional capability and the growing expectation that students will manage essential academic activity through digital systems. The key distributional question is whether students can participate consistently rather than ration data or postpone learning activities. Studies across tertiary environments show that high data prices, unstable networks and shared hardware can turn formally universal digital provision into materially unequal learning conditions (Jiang et al., 2025; Zhao, 2023). This difference deserves attention because formal access to a platform does not ensure meaningful participation, and participation does not necessarily yield comparable continuity. Within affordability connectivity device constraints limiting student participation, students with greater financial, social and technological resources can often buffer disruption through purchasing data, replacing devices, seeking private assistance or changing study locations, while resource-constrained learners possess fewer ways to compensate. Within affordability connectivity device constraints limiting student participation, accordingly, digital inequality operates as an unequal conversion process in which similar technologies produce different academic possibilities depending on the resources surrounding each learner. Within affordability connectivity device constraints limiting student participation, universities should assess access together with the practical conditions that determine whether digital tools can be used repeatedly, effectively and purposefully. A robust institutional equity approach needs to connect affordable connectivity with curriculum design, academic support and measurable student outcomes instead of treating it as an isolated information technology responsibility.

Comparative evidence indicates that affordable connectivity depends closely on the institutional and social conditions surrounding learners. In rapidly digitalising emerging economies, affordable connectivity develops through uneven infrastructure, household resources, institutional capability and the growing expectation that students will manage essential academic activity through digital systems. The main equity test is whether students can participate consistently rather than ration data or postpone learning activities. Evidence from higher education settings indicates that high data prices, unstable networks and shared hardware can turn formally universal digital provision into materially unequal learning conditions (Yusof et al., 2025; Kamarudin et al., 2025). The difference has practical significance because formal access to a platform does not ensure meaningful participation, and participation does not necessarily yield comparable continuity. Within affordability connectivity device constraints limiting student participation, students possessing

broader financial, relational and technological resources can respond to disruption through purchasing data, replacing devices, seeking private assistance or changing study locations, while resource-constrained learners possess fewer ways to compensate. Within affordability connectivity device constraints limiting student participation, this pattern positions digital inequality as a conversion problem whereby similar technologies produce different academic possibilities depending on the resources surrounding each learner. Within affordability connectivity device constraints limiting student participation, higher education providers need to judge digital access by the reliability, confidence and academic purpose that students can sustain over time. A credible digital opportunity strategy should therefore link affordable connectivity with curriculum design, academic support and measurable student outcomes instead of treating it as an isolated information technology responsibility.

3.2 Unequal Digital AI Literacies Restricting Academic Autonomy

Unequal digital and AI literacies have become more consequential as universities embed sophisticated platforms and generative tools into ordinary study. Within higher education in emerging economies, advanced literacy develops through uneven infrastructure, household resources, institutional capability and the growing expectation that students will manage essential academic activity through digital systems. The key distributional question is whether students can judge outputs, verify evidence, formulate prompts and understand the limits of automated systems. Studies across tertiary environments show that unequal training and rapidly changing technologies can turn formally universal digital provision into materially unequal learning conditions (Yusof, Abdul Razak, Misnan, & Abdul Malik, 2026). This difference deserves attention because formal access to a platform does not ensure meaningful participation, and participation does not necessarily yield comparable academic autonomy. Within unequal digital ai literacies restricting academic autonomy, students with greater financial, social and technological resources can often buffer disruption through purchasing data, replacing devices, seeking private assistance or changing study locations, while resource-constrained learners possess fewer ways to compensate. Within unequal digital ai literacies restricting academic autonomy, accordingly, digital inequality operates as an unequal conversion process in which similar technologies produce different academic possibilities depending on the resources surrounding each learner. Within unequal digital ai literacies restricting academic autonomy, universities should assess access together with the practical conditions that determine whether digital tools can be used repeatedly, effectively and purposefully. A robust institutional equity approach needs to connect advanced literacy with curriculum design, academic support and measurable student outcomes instead of treating it as an isolated information technology responsibility.

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3.3 Rural Gender Socioeconomic Intersections Deepening Digital Disadvantage

Contemporary digital disadvantage often intensifies where socioeconomic status, geography and gender intersect rather than operating as separate variables. Within higher education in emerging economies, intersecting inequality develops through uneven infrastructure, household resources, institutional capability and the growing expectation that students will manage essential academic activity through digital systems. The key distributional question is whether students can access comparable opportunities regardless of household resources or place of residence. Studies across tertiary environments show that rural infrastructure gaps, gendered norms and household constraints can turn formally universal digital provision into materially unequal learning conditions (Barra et al., 2024; Michikyan et al., 2025). This difference deserves attention because formal access to a platform does not ensure meaningful participation, and participation does not necessarily yield comparable equity. Within rural gender socioeconomic intersections deepening digital disadvantage, students with greater financial, social and technological resources can often buffer disruption through purchasing data, replacing devices, seeking private assistance or changing study locations, while resource-constrained learners possess fewer ways to compensate. Within rural gender socioeconomic intersections deepening digital disadvantage, accordingly, digital inequality operates as an unequal conversion process in which similar technologies produce different academic possibilities depending on the resources surrounding each learner. Within rural gender socioeconomic intersections deepening digital disadvantage, universities should assess access together with the practical conditions that determine whether digital tools can be used repeatedly, effectively and purposefully. A robust institutional equity approach needs to connect intersecting inequality with curriculum design, academic support and measurable student outcomes instead of treating it as an isolated information technology responsibility. (Maji & Laha, 2022).

Closer analysis demonstrates that intersecting inequality depends closely on the institutional and social conditions surrounding learners. In rapidly digitalising emerging economies, intersecting inequality develops through uneven infrastructure, household resources, institutional capability and the growing expectation that students will manage essential academic activity through digital systems. The main equity test is whether students can access comparable opportunities regardless of household resources or place of residence. Evidence from higher education settings indicates that rural infrastructure gaps, gendered norms and household constraints can turn formally universal digital provision into materially unequal learning conditions (Katz et al., 2021; Katz et al., 2025).

The difference has practical significance because formal access to a platform does not ensure meaningful participation, and participation does not necessarily yield comparable equity. Within rural gender socioeconomic intersections deepening digital disadvantage, students possessing broader financial, relational and technological resources can respond to disruption through purchasing data, replacing devices, seeking private assistance or changing study locations, while resource-constrained learners possess fewer ways to compensate. Within rural gender socioeconomic intersections deepening digital disadvantage, this pattern positions digital inequality as a conversion problem whereby similar technologies produce different academic possibilities depending on the resources surrounding each learner. Within rural gender socioeconomic intersections deepening digital disadvantage, higher education providers need to judge digital access by the reliability, confidence and academic purpose that students can sustain over time. A credible digital opportunity strategy should therefore link intersecting inequality with curriculum design, academic support and measurable student outcomes instead of treating it as an isolated information technology responsibility.

3.4 Platform Dependence Creating Unequal Student Learning Conditions

Dependence on digital platforms can create hidden educational barriers when course design assumes uninterrupted broadband, powerful devices and constant synchronous presence. Within higher education in emerging economies, platform conditions develops through uneven infrastructure, household resources, institutional capability and the growing expectation that students will manage essential academic activity through digital systems. The key distributional question is whether students can meet learning requirements through accessible and flexible pathways. Studies across tertiary environments show that bandwidth-heavy design, inaccessible interfaces and rigid participation rules can turn formally universal digital provision into materially unequal learning conditions (Yusof, Abdul Razak, Mat Zin, & Abdulloh, 2025). This difference deserves attention because formal access to a platform does not ensure meaningful participation, and participation does not necessarily yield comparable fair participation. Within platform dependence creating unequal student learning conditions, students with greater financial, social and technological resources can often buffer disruption through purchasing data, replacing devices, seeking private assistance or changing study locations, while resource-constrained learners possess fewer ways to compensate. Within platform dependence creating unequal student learning conditions, accordingly, digital inequality operates as an unequal conversion process in which similar technologies produce different academic possibilities depending on the resources surrounding each learner. Within platform dependence creating unequal student learning conditions, universities should assess access together with the practical conditions that determine whether digital tools can be used repeatedly, effectively and purposefully. A robust institutional equity approach needs to connect platform conditions with curriculum design, academic support and measurable student outcomes instead of treating it as an isolated information technology responsibility. (Nayak & Alam, 2022).

Its strategic importance becomes clearer when platform conditions depends closely on the institutional and social conditions surrounding learners. In rapidly digitalising emerging economies, platform conditions develops through uneven infrastructure, household resources, institutional capability and the growing expectation that students will manage essential academic activity through digital systems. The main equity test is whether students can meet learning requirements through accessible and flexible pathways. Evidence from higher education settings indicates that bandwidth-

heavy design, inaccessible interfaces and rigid participation rules can turn formally universal digital provision into materially unequal learning conditions (Scheerder et al., 2017; van Deursen & van Dijk, 2019). The difference has practical significance because formal access to a platform does not ensure meaningful participation, and participation does not necessarily yield comparable fair participation. Within platform dependence creating unequal student learning conditions, students possessing broader financial, relational and technological resources can respond to disruption through purchasing data, replacing devices, seeking private assistance or changing study locations, while resource-constrained learners possess fewer ways to compensate. Within platform dependence creating unequal student learning conditions, this pattern positions digital inequality as a conversion problem whereby similar technologies produce different academic possibilities depending on the resources surrounding each learner. Within platform dependence creating unequal student learning conditions, higher education providers need to judge digital access by the reliability, confidence and academic purpose that students can sustain over time. A credible digital opportunity strategy should therefore link platform conditions with curriculum design, academic support and measurable student outcomes instead of treating it as an isolated information technology responsibility.

3.5 Institutional Capacity Deficits Weakening Sustainable Digital Inclusion

Institutional capability strongly determines whether digital inclusion is embedded in routine academic systems or left to temporary projects and individual goodwill. Within higher education in emerging economies, institutional capacity develops through uneven infrastructure, household resources, institutional capability and the growing expectation that students will manage essential academic activity through digital systems. The key distributional question is whether students can obtain coordinated technical, academic and financial support when barriers emerge. Studies across tertiary environments show that fragmented ownership, weak data and short-term funding can turn formally universal digital provision into materially unequal learning conditions (Yusof, Fauzi, Jamaludin, et al., 2025). This difference deserves attention because formal access to a platform does not ensure meaningful participation, and participation does not necessarily yield comparable system resilience. Within institutional capacity deficits weakening sustainable digital inclusion, students with greater financial, social and technological resources can often buffer disruption through purchasing data, replacing devices, seeking private assistance or changing study locations, while resource-constrained learners possess fewer ways to compensate. Within institutional capacity deficits weakening sustainable digital inclusion, accordingly, digital inequality operates as an unequal conversion process in which similar technologies produce different academic possibilities depending on the resources surrounding each learner. Within institutional capacity deficits weakening sustainable digital inclusion, universities should assess access together with the practical conditions that determine whether digital tools can be used repeatedly, effectively and purposefully. A robust institutional equity approach needs to connect institutional capacity with curriculum design, academic support and measurable student outcomes instead of treating it as an isolated information technology responsibility.

An outcome-focused interpretation demonstrates that institutional capacity depends closely on the institutional and social conditions surrounding learners. In rapidly digitalising emerging economies, institutional capacity develops through uneven infrastructure, household resources, institutional capability and the growing expectation that students will manage essential academic activity through digital systems. The main equity test is whether students can obtain coordinated technical, academic

and financial support when barriers emerge. Evidence from higher education settings indicates that fragmented ownership, weak data and short-term funding can turn formally universal digital provision into materially unequal learning conditions (Hargittai, 2002; Helsper, 2012). The difference has practical significance because formal access to a platform does not ensure meaningful participation, and participation does not necessarily yield comparable system resilience. Within institutional capacity deficits weakening sustainable digital inclusion, students possessing broader financial, relational and technological resources can respond to disruption through purchasing data, replacing devices, seeking private assistance or changing study locations, while resource-constrained learners possess fewer ways to compensate. Within institutional capacity deficits weakening sustainable digital inclusion, this pattern positions digital inequality as a conversion problem whereby similar technologies produce different academic possibilities depending on the resources surrounding each learner. Within institutional capacity deficits weakening sustainable digital inclusion, higher education providers need to judge digital access by the reliability, confidence and academic purpose that students can sustain over time. A credible digital opportunity strategy should therefore link institutional capacity with curriculum design, academic support and measurable student outcomes instead of treating it as an isolated information technology responsibility.

4.0 DIGITAL INEQUALITY MECHANISMS SHAPING STUDENT EDUCATIONAL OPPORTUNITY

Contemporary digital inequality affects educational opportunity through mechanisms that connect resources to participation and participation to outcomes. A device has educational value only when it is functional; connected, affordable to use and compatible with required learning activities. Contemporary digital skills become consequential when students can apply them to information evaluation, academic production, collaboration and emerging AI-supported tasks. Social position further influences whether learners possess quiet study space; technical assistance, time and confidence to recover from digital disruption. These conversion processes explain why identical platforms may produce unequal experiences and why infrastructure investments alone rarely eliminate educational disadvantage. Research increasingly supports a multilevel interpretation in which access; skills, use and outcomes reinforce one another (Michikyan et al., 2025; Passey et al., 2024). Importantly, the following analysis interprets each challenge as part of a connected opportunity system rather than as a stand-alone digital problem.

4.1 Reliable Digital Access Sustaining Continuous Student Participation

Reliable access shapes opportunity through the simple but powerful mechanism of continuity across repeated learning interactions. Within emerging-economy university environments, access continuity develops through uneven infrastructure, household resources, institutional capability and the growing expectation that students will manage essential academic activity through digital systems. The central equity concern asks whether students can maintain attendance, preparation, submission and feedback cycles. Research across university contexts demonstrates that interruption and accumulated delay can turn formally universal digital provision into materially unequal learning conditions (Gulzar et al., 2024; Madhubhashini, 2022). This separation matters analytically because formal access to a platform does not ensure meaningful participation, and participation does not necessarily yield comparable progression. Within reliable digital access sustaining continuous student participation, better-resourced learners can compensate for digital disruption by purchasing data, replacing devices, seeking private assistance or changing study locations, while resource-

constrained learners possess fewer ways to compensate. Within reliable digital access sustaining continuous student participation, digital inequality thus emerges through differential conversion, where similar technologies produce different academic possibilities depending on the resources surrounding each learner. Within reliable digital access sustaining continuous student participation, universities must therefore evaluate both technological availability and the conditions that allow students to use digital resources consistently, confidently and with academic purpose. An effective digital equity agenda must connect access continuity with curriculum design, academic support and measurable student outcomes instead of treating it as an isolated information technology responsibility.

Comparative evidence indicates that access continuity must be interpreted together with the institutional and social conditions surrounding students. Within higher education in emerging economies, access continuity develops through uneven infrastructure, household resources, institutional capability and the growing expectation that students will manage essential academic activity through digital systems. The key distributional question is whether students can maintain attendance, preparation, submission and feedback cycles. Studies across tertiary environments show that interruption and accumulated delay can turn formally universal digital provision into materially unequal learning conditions (Hong et al., 2024; Zhang et al., 2026). This difference deserves attention because formal access to a platform does not ensure meaningful participation, and participation does not necessarily yield comparable progression. Within reliable digital access sustaining continuous student participation, students with greater financial, social and technological resources can often buffer disruption through purchasing data, replacing devices, seeking private assistance or changing study locations, while resource-constrained learners possess fewer ways to compensate. Within reliable digital access sustaining continuous student participation, accordingly, digital inequality operates as an unequal conversion process in which similar technologies produce different academic possibilities depending on the resources surrounding each learner. Within reliable digital access sustaining continuous student participation, universities should assess access together with the practical conditions that determine whether digital tools can be used repeatedly, effectively and purposefully. A robust institutional equity approach needs to connect access continuity with curriculum design, academic support and measurable student outcomes instead of treating it as an isolated information technology responsibility.

4.2 Capability Conversion Strengthening Digital Skills Academic Agency

Contemporary digital skills create educational value when they are converted into agency within authentic academic tasks rather than taught as detached technical procedures. Within emerging-economy university environments, capability conversion develops through uneven infrastructure, household resources, institutional capability and the growing expectation that students will manage essential academic activity through digital systems. The central equity concern asks whether students can choose strategies, solve problems and recover independently from routine digital obstacles. Research across university contexts demonstrates that skills training disconnected from disciplinary practice can turn formally universal digital provision into materially unequal learning conditions (Jiang et al., 2025; Zhao, 2023). This separation matters analytically because formal access to a platform does not ensure meaningful participation, and participation does not necessarily yield comparable agency. Within capability conversion strengthening digital skills academic agency, better-resourced learners can compensate for digital disruption by purchasing data, replacing

devices, seeking private assistance or changing study locations, while resource-constrained learners possess fewer ways to compensate. Within capability conversion strengthening digital skills academic agency, digital inequality thus emerges through differential conversion, where similar technologies produce different academic possibilities depending on the resources surrounding each learner. Within capability conversion strengthening digital skills academic agency, universities must therefore evaluate both technological availability and the conditions that allow students to use digital resources consistently, confidently and with academic purpose. An effective digital equity agenda must connect capability conversion with curriculum design, academic support and measurable student outcomes instead of treating it as an isolated information technology responsibility.

The relationship becomes particularly important when capability conversion must be interpreted together with the institutional and social conditions surrounding students. Within higher education in emerging economies, capability conversion develops through uneven infrastructure, household resources, institutional capability and the growing expectation that students will manage essential academic activity through digital systems. The key distributional question is whether students can choose strategies, solve problems and recover independently from routine digital obstacles. Studies across tertiary environments show that skills training disconnected from disciplinary practice can turn formally universal digital provision into materially unequal learning conditions (Yusof et al., 2025; Kamarudin et al., 2025). This difference deserves attention because formal access to a platform does not ensure meaningful participation, and participation does not necessarily yield comparable agency. Within capability conversion strengthening digital skills academic agency, students with greater financial, social and technological resources can often buffer disruption through purchasing data, replacing devices, seeking private assistance or changing study locations, while resource-constrained learners possess fewer ways to compensate. Within capability conversion strengthening digital skills academic agency, accordingly, digital inequality operates as an unequal conversion process in which similar technologies produce different academic possibilities depending on the resources surrounding each learner. Within capability conversion strengthening digital skills academic agency, universities should assess access together with the practical conditions that determine whether digital tools can be used repeatedly, effectively and purposefully. A robust institutional equity approach needs to connect capability conversion with curriculum design, academic support and measurable student outcomes instead of treating it as an isolated information technology responsibility.

4.3 Social Position Multiplying Unequal Digital Educational Advantages

Social position can multiply digital advantage because technology is used within households and communities that distribute time, space, assistance and expectations unevenly. Within emerging-economy university environments, social multiplication develops through uneven infrastructure, household resources, institutional capability and the growing expectation that students will manage essential academic activity through digital systems. The central equity concern asks whether students can draw on supportive environments as well as digital resources. Research across university contexts demonstrates that resource-rich networks versus constrained learning environments can turn formally universal digital provision into materially unequal learning conditions (Yusof, Razak, Jamaludin, et al., 2025; Zaini et al., 2026). This separation matters analytically because formal access to a platform does not ensure meaningful participation, and participation does not necessarily yield comparable cumulative advantage. Within social position multiplying unequal digital educational

advantages, better-resourced learners can compensate for digital disruption by purchasing data, replacing devices, seeking private assistance or changing study locations, while resource-constrained learners possess fewer ways to compensate. Within social position multiplying unequal digital educational advantages, digital inequality thus emerges through differential conversion, where similar technologies produce different academic possibilities depending on the resources surrounding each learner. Within social position multiplying unequal digital educational advantages, universities must therefore evaluate both technological availability and the conditions that allow students to use digital resources consistently, confidently and with academic purpose. An effective digital equity agenda must connect social multiplication with curriculum design, academic support and measurable student outcomes instead of treating it as an isolated information technology responsibility.

Closer analysis demonstrates that social multiplication must be interpreted together with the institutional and social conditions surrounding students. Within higher education in emerging economies, social multiplication develops through uneven infrastructure, household resources, institutional capability and the growing expectation that students will manage essential academic activity through digital systems. The key distributional question is whether students can draw on supportive environments as well as digital resources. Studies across tertiary environments show that resource-rich networks versus constrained learning environments can turn formally universal digital provision into materially unequal learning conditions (Clamor & Saloma, 2023; Devisakti et al., 2024). This difference deserves attention because formal access to a platform does not ensure meaningful participation, and participation does not necessarily yield comparable cumulative advantage. Within social position multiplying unequal digital educational advantages, students with greater financial, social and technological resources can often buffer disruption through purchasing data, replacing devices, seeking private assistance or changing study locations, while resource-constrained learners possess fewer ways to compensate. Within social position multiplying unequal digital educational advantages, accordingly, digital inequality operates as an unequal conversion process in which similar technologies produce different academic possibilities depending on the resources surrounding each learner. Within social position multiplying unequal digital educational advantages, universities should assess access together with the practical conditions that determine whether digital tools can be used repeatedly, effectively and purposefully. A robust institutional equity approach needs to connect social multiplication with curriculum design, academic support and measurable student outcomes instead of treating it as an isolated information technology responsibility.

4.4 Pedagogical Design Mediating Platform Based Learning Inequality

Pedagogical design can mediate digital inequality because the same technology can either widen participation or amplify barriers depending on how learning is organised. Within emerging-economy university environments, inclusive pedagogy develops through uneven infrastructure, household resources, institutional capability and the growing expectation that students will manage essential academic activity through digital systems. The central equity concern asks whether students can engage through multiple modes without lowering academic standards. Research across university contexts demonstrates that technology-first design and inflexible assessment can turn formally universal digital provision into materially unequal learning conditions (Barra et al., 2024; Michikyan et al., 2025). This separation matters analytically because formal access to a platform does not ensure

meaningful participation, and participation does not necessarily yield comparable learning accessibility. Within pedagogical design mediating platform based learning inequality, better-resourced learners can compensate for digital disruption by purchasing data, replacing devices, seeking private assistance or changing study locations, while resource-constrained learners possess fewer ways to compensate. Within pedagogical design mediating platform based learning inequality, digital inequality thus emerges through differential conversion, where similar technologies produce different academic possibilities depending on the resources surrounding each learner. Within pedagogical design mediating platform based learning inequality, universities must therefore evaluate both technological availability and the conditions that allow students to use digital resources consistently, confidently and with academic purpose. An effective digital equity agenda must connect inclusive pedagogy with curriculum design, academic support and measurable student outcomes instead of treating it as an isolated information technology responsibility.

Its strategic importance becomes clearer when inclusive pedagogy must be interpreted together with the institutional and social conditions surrounding students. Within higher education in emerging economies, inclusive pedagogy develops through uneven infrastructure, household resources, institutional capability and the growing expectation that students will manage essential academic activity through digital systems. The key distributional question is whether students can engage through multiple modes without lowering academic standards. Studies across tertiary environments show that technology-first design and inflexible assessment can turn formally universal digital provision into materially unequal learning conditions (Katz et al., 2021; Katz et al., 2025). This difference deserves attention because formal access to a platform does not ensure meaningful participation, and participation does not necessarily yield comparable learning accessibility. Within pedagogical design mediating platform based learning inequality, students with greater financial, social and technological resources can often buffer disruption through purchasing data, replacing devices, seeking private assistance or changing study locations, while resource-constrained learners possess fewer ways to compensate. Within pedagogical design mediating platform based learning inequality, accordingly, digital inequality operates as an unequal conversion process in which similar technologies produce different academic possibilities depending on the resources surrounding each learner. Within pedagogical design mediating platform based learning inequality, universities should assess access together with the practical conditions that determine whether digital tools can be used repeatedly, effectively and purposefully. A robust institutional equity approach needs to connect inclusive pedagogy with curriculum design, academic support and measurable student outcomes instead of treating it as an isolated information technology responsibility.

4.5 Institutional Orchestration Strengthening Equitable Student Digital Outcomes

Institutional orchestration represents the mechanism that connects infrastructure, teaching, student support and governance into a coherent digital opportunity system. Across emerging-economy higher education systems, institutional orchestration develops through uneven infrastructure, household resources, institutional capability and the growing expectation that students will manage essential academic activity through digital systems. A decisive equity issue concerns whether students experience consistent support across courses and services. Comparative higher education evidence suggests that siloed decisions and incompatible systems can turn formally universal digital provision into materially unequal learning conditions (Passey et al., 2024; Qin et al., 2024). The distinction carries educational consequences because formal access to a platform does not ensure

meaningful participation, and participation does not necessarily yield comparable equitable outcomes. Within institutional orchestration strengthening equitable student digital outcomes, students with stronger resource portfolios can reduce disruption through purchasing data, replacing devices, seeking private assistance or changing study locations, while resource-constrained learners possess fewer ways to compensate. Within institutional orchestration strengthening equitable student digital outcomes, digital inequality is therefore better understood as a differential conversion process whereby similar technologies produce different academic possibilities depending on the resources surrounding each learner. Within institutional orchestration strengthening equitable student digital outcomes, institutional evaluation should move beyond availability and examine whether students can use digital systems reliably, confidently and in ways that support learning. A meaningful educational opportunity strategy should integrate institutional orchestration with curriculum design, academic support and measurable student outcomes instead of treating it as an isolated information technology responsibility.

An outcome-focused interpretation demonstrates that institutional orchestration is inseparable from the institutional and social conditions shaping student experience. Across resource-diverse emerging economies, institutional orchestration develops through uneven infrastructure, household resources, institutional capability and the growing expectation that students will manage essential academic activity through digital systems. A fundamental opportunity question is whether students experience consistent support across courses and services. Available university evidence indicates that siloed decisions and incompatible systems can turn formally universal digital provision into materially unequal learning conditions (Scheerder et al., 2017; van Deursen & van Dijk, 2019). This distinction is important because formal access to a platform does not ensure meaningful participation, and participation does not necessarily yield comparable equitable outcomes. Within institutional orchestration strengthening equitable student digital outcomes, learners with stronger economic, social and digital resources can usually manage disruption by purchasing data, replacing devices, seeking private assistance or changing study locations, while resource-constrained learners possess fewer ways to compensate. Within institutional orchestration strengthening equitable student digital outcomes, digital inequality consequently reflects unequal conversion, meaning that similar technologies produce different academic possibilities depending on the resources surrounding each learner. Within institutional orchestration strengthening equitable student digital outcomes, institutional scrutiny must consider not just provision, but whether students can sustain confident and purposeful digital participation across normal academic routines. A sustainable digital opportunity framework should align institutional orchestration with curriculum design, academic support and measurable student outcomes instead of treating it as an isolated information technology responsibility.

5.0 STRATEGIC DIGITAL EQUITY PATHWAYS STRENGTHENING HIGHER EDUCATION

Reducing digital inequality requires institutions to shift beyond short-term technology provision toward a coherent capability and opportunity strategy. Effective action must combine affordable access; curriculum-embedded digital literacy, targeted support for disadvantaged groups, inclusive learning design and governance that measures who actually benefits from digital education. This approach recognises that equal provision does not automatically generate equitable outcomes because students enter digital learning with different resources; constraints and prior experiences.

Importantly, it also avoids treating digitally disadvantaged students as deficient users who simply require more motivation. Instead; responsibility is shared across infrastructure planning, pedagogy, student services, assessment, data governance and public policy. Importantly, the five pathways developed below translate the preceding mechanisms into implementable institutional responses. Their common objective is to ensure that digital transformation expands educational capability and progression rather than reproducing socioeconomic; geographic or gender inequalities in a technologically modern form.

5.1 Affordable Resilient Access Ecosystems Supporting Student Participation

Universities need to treat affordable digital access as core learning infrastructure and design support around the full cost of participation. In rapidly digitalising emerging economies, access ecosystems develops through uneven infrastructure, household resources, institutional capability and the growing expectation that students will manage essential academic activity through digital systems. The main equity test is whether students can secure devices, connectivity, software and repair support across the academic year. Evidence from higher education settings indicates that one-off device schemes and narrowly defined access metrics can turn formally universal digital provision into materially unequal learning conditions (Lybeck et al., 2024; Ragnedda, 2018). The difference has practical significance because formal access to a platform does not ensure meaningful participation, and participation does not necessarily yield comparable sustainable access. Within affordable resilient access ecosystems supporting student participation, students possessing broader financial, relational and technological resources can respond to disruption through purchasing data, replacing devices, seeking private assistance or changing study locations, while resource-constrained learners possess fewer ways to compensate. Within affordable resilient access ecosystems supporting student participation, this pattern positions digital inequality as a conversion problem whereby similar technologies produce different academic possibilities depending on the resources surrounding each learner. Within affordable resilient access ecosystems supporting student participation, higher education providers need to judge digital access by the reliability, confidence and academic purpose that students can sustain over time. A credible digital opportunity strategy should therefore link access ecosystems with curriculum design, academic support and measurable student outcomes instead of treating it as an isolated information technology responsibility.

Comparative evidence indicates that access ecosystems is deeply conditioned by institutional arrangements and students' wider social circumstances. Across emerging-economy higher education systems, access ecosystems develops through uneven infrastructure, household resources, institutional capability and the growing expectation that students will manage essential academic activity through digital systems. A decisive equity issue concerns whether students can secure devices, connectivity, software and repair support across the academic year. Comparative higher education evidence suggests that one-off device schemes and narrowly defined access metrics can turn formally universal digital provision into materially unequal learning conditions (Hargittai, 2002; Helsper, 2012). The distinction carries educational consequences because formal access to a platform does not ensure meaningful participation, and participation does not necessarily yield comparable sustainable access. Within affordable resilient access ecosystems supporting student participation, students with stronger resource portfolios can reduce disruption through purchasing data, replacing devices, seeking private assistance or changing study locations, while resource-constrained learners possess fewer ways to compensate. Within affordable resilient access

ecosystems supporting student participation, digital inequality is therefore better understood as a differential conversion process whereby similar technologies produce different academic possibilities depending on the resources surrounding each learner. Within affordable resilient access ecosystems supporting student participation, institutional evaluation should move beyond availability and examine whether students can use digital systems reliably, confidently and in ways that support learning. A meaningful educational opportunity strategy should integrate access ecosystems with curriculum design, academic support and measurable student outcomes instead of treating it as an isolated information technology responsibility.

5.2 Curriculum Embedded Digital AI Literacy Strengthening Student Capability

Digital and AI literacy should be progressively embedded across curricula so that capability develops through repeated disciplinary application. In rapidly digitalising emerging economies, curricular literacy develops through uneven infrastructure, household resources, institutional capability and the growing expectation that students will manage essential academic activity through digital systems. The main equity test is whether students can build critical, ethical and practical competence at increasing levels of complexity. Evidence from higher education settings indicates that optional workshops and uneven lecturer expectations can turn formally universal digital provision into materially unequal learning conditions (Gulzar et al., 2024; Madhubhashini, 2022). The difference has practical significance because formal access to a platform does not ensure meaningful participation, and participation does not necessarily yield comparable capability development. Within curriculum embedded digital ai literacy strengthening student capability, students possessing broader financial, relational and technological resources can respond to disruption through purchasing data, replacing devices, seeking private assistance or changing study locations, while resource-constrained learners possess fewer ways to compensate. Within curriculum embedded digital ai literacy strengthening student capability, this pattern positions digital inequality as a conversion problem whereby similar technologies produce different academic possibilities depending on the resources surrounding each learner. Within curriculum embedded digital ai literacy strengthening student capability, higher education providers need to judge digital access by the reliability, confidence and academic purpose that students can sustain over time. A credible digital opportunity strategy should therefore link curricular literacy with curriculum design, academic support and measurable student outcomes instead of treating it as an isolated information technology responsibility. (Yusof, 2025a, 2025b).

The relationship becomes particularly important when curricular literacy is deeply conditioned by institutional arrangements and students' wider social circumstances. Across emerging-economy higher education systems, curricular literacy develops through uneven infrastructure, household resources, institutional capability and the growing expectation that students will manage essential academic activity through digital systems. A decisive equity issue concerns whether students can build critical, ethical and practical competence at increasing levels of complexity. Comparative higher education evidence suggests that optional workshops and uneven lecturer expectations can turn formally universal digital provision into materially unequal learning conditions (Hong et al., 2024; Zhang et al., 2026). The distinction carries educational consequences because formal access to a platform does not ensure meaningful participation, and participation does not necessarily yield comparable capability development. Within curriculum embedded digital ai literacy strengthening student capability, students with stronger resource portfolios can reduce disruption through

purchasing data, replacing devices, seeking private assistance or changing study locations, while resource-constrained learners possess fewer ways to compensate. Within curriculum embedded digital ai literacy strengthening student capability, digital inequality is therefore better understood as a differential conversion process whereby similar technologies produce different academic possibilities depending on the resources surrounding each learner. Within curriculum embedded digital ai literacy strengthening student capability, institutional evaluation should move beyond availability and examine whether students can use digital systems reliably, confidently and in ways that support learning. A meaningful educational opportunity strategy should integrate curricular literacy with curriculum design, academic support and measurable student outcomes instead of treating it as an isolated information technology responsibility.

5.3 Targeted Inclusion Addressing Intersecting Student Digital Disadvantages

Equity strategies should prioritise intersecting disadvantages rather than distribute identical support to students with substantially different constraints. In rapidly digitalising emerging economies, targeted inclusion develops through uneven infrastructure, household resources, institutional capability and the growing expectation that students will manage essential academic activity through digital systems. The main equity test is whether students can receive support proportionate to barriers associated with income, geography, gender, disability or first-generation status. Evidence from higher education settings indicates that universal schemes that overlook differentiated need can turn formally universal digital provision into materially unequal learning conditions (Jiang et al., 2025; Zhao, 2023). The difference has practical significance because formal access to a platform does not ensure meaningful participation, and participation does not necessarily yield comparable substantive equity. Within targeted inclusion addressing intersecting student digital disadvantages, students possessing broader financial, relational and technological resources can respond to disruption through purchasing data, replacing devices, seeking private assistance or changing study locations, while resource-constrained learners possess fewer ways to compensate. Within targeted inclusion addressing intersecting student digital disadvantages, this pattern positions digital inequality as a conversion problem whereby similar technologies produce different academic possibilities depending on the resources surrounding each learner. Within targeted inclusion addressing intersecting student digital disadvantages, higher education providers need to judge digital access by the reliability, confidence and academic purpose that students can sustain over time. A credible digital opportunity strategy should therefore link targeted inclusion with curriculum design, academic support and measurable student outcomes instead of treating it as an isolated information technology responsibility.

Closer analysis demonstrates that targeted inclusion is deeply conditioned by institutional arrangements and students' wider social circumstances. Across emerging-economy higher education systems, targeted inclusion develops through uneven infrastructure, household resources, institutional capability and the growing expectation that students will manage essential academic activity through digital systems. A decisive equity issue concerns whether students can receive support proportionate to barriers associated with income, geography, gender, disability or first-generation status. Comparative higher education evidence suggests that universal schemes that overlook differentiated need can turn formally universal digital provision into materially unequal learning conditions (Yusof et al., 2025; Kamarudin et al., 2025). The distinction carries educational consequences because formal access to a platform does not ensure meaningful participation, and

participation does not necessarily yield comparable substantive equity. Within targeted inclusion addressing intersecting student digital disadvantages, students with stronger resource portfolios can reduce disruption through purchasing data, replacing devices, seeking private assistance or changing study locations, while resource-constrained learners possess fewer ways to compensate. Within targeted inclusion addressing intersecting student digital disadvantages, digital inequality is therefore better understood as a differential conversion process whereby similar technologies produce different academic possibilities depending on the resources surrounding each learner. Within targeted inclusion addressing intersecting student digital disadvantages, institutional evaluation should move beyond availability and examine whether students can use digital systems reliably, confidently and in ways that support learning. A meaningful educational opportunity strategy should integrate targeted inclusion with curriculum design, academic support and measurable student outcomes instead of treating it as an isolated information technology responsibility.

5.4 Low Friction Learning Design Strengthening Inclusive Participation

Inclusive digital learning should begin with constrained learning conditions, with richer technological features added only where they strengthen learning. Within emerging-economy university environments, low-friction design develops through uneven infrastructure, household resources, institutional capability and the growing expectation that students will manage essential academic activity through digital systems. The central equity concern asks whether students can participate through low-bandwidth, mobile-compatible and accessible routes. Research across university contexts demonstrates that synchronous overload and device-intensive tasks can turn formally universal digital provision into materially unequal learning conditions (Adarkwah, 2021; Subramaniam et al., 2024). This separation matters analytically because formal access to a platform does not ensure meaningful participation, and participation does not necessarily yield comparable inclusive engagement. Within low friction learning design strengthening inclusive participation, better-resourced learners can compensate for digital disruption by purchasing data, replacing devices, seeking private assistance or changing study locations, while resource-constrained learners possess fewer ways to compensate. Within low friction learning design strengthening inclusive participation, digital inequality thus emerges through differential conversion, where similar technologies produce different academic possibilities depending on the resources surrounding each learner. Within low friction learning design strengthening inclusive participation, universities must therefore evaluate both technological availability and the conditions that allow students to use digital resources consistently, confidently and with academic purpose. An effective digital equity agenda must connect low-friction design with curriculum design, academic support and measurable student outcomes instead of treating it as an isolated information technology responsibility. (Okai-Ugbaje et al., 2022).

Its strategic importance becomes clearer when low-friction design must be interpreted together with the institutional and social conditions surrounding students. Within higher education in emerging economies, low-friction design develops through uneven infrastructure, household resources, institutional capability and the growing expectation that students will manage essential academic activity through digital systems. The key distributional question is whether students can participate through low-bandwidth, mobile-compatible and accessible routes. Studies across tertiary environments show that synchronous overload and device-intensive tasks can turn formally

universal digital provision into materially unequal learning conditions (Clamor & Saloma, 2023; Devisakti et al., 2024). This difference deserves attention because formal access to a platform does not ensure meaningful participation, and participation does not necessarily yield comparable inclusive engagement. Within low friction learning design strengthening inclusive participation, students with greater financial, social and technological resources can often buffer disruption through purchasing data, replacing devices, seeking private assistance or changing study locations, while resource-constrained learners possess fewer ways to compensate. Within low friction learning design strengthening inclusive participation, accordingly, digital inequality operates as an unequal conversion process in which similar technologies produce different academic possibilities depending on the resources surrounding each learner. Within low friction learning design strengthening inclusive participation, universities should assess access together with the practical conditions that determine whether digital tools can be used repeatedly, effectively and purposefully. A robust institutional equity approach needs to connect low-friction design with curriculum design, academic support and measurable student outcomes instead of treating it as an isolated information technology responsibility.

5.5 Outcome Based Digital Equity Governance Strengthening Accountability

Digital equity governance should evaluate outcomes instead of treating technology adoption as evidence of successful transformation. Within emerging-economy university environments, outcome governance develops through uneven infrastructure, household resources, institutional capability and the growing expectation that students will manage essential academic activity through digital systems. The central equity concern asks whether institutions can identify who participates, who benefits and where digital disadvantage persists. Research across university contexts demonstrates that input-focused metrics and weak accountability can turn formally universal digital provision into materially unequal learning conditions (Barra et al., 2024; Michikyan et al., 2025). Within outcome based digital equity governance strengthening accountability, this separation matters analytically because formal access to a platform does not ensure meaningful participation, and participation does not necessarily yield comparable educational opportunity. Within outcome based digital equity governance strengthening accountability, better-resourced learners can compensate for digital disruption by purchasing data, replacing devices, seeking private assistance or changing study locations, while resource-constrained learners possess fewer ways to compensate. Within outcome based digital equity governance strengthening accountability, digital inequality thus emerges through differential conversion, where similar technologies produce different academic possibilities depending on the resources surrounding each learner. Within outcome based digital equity governance strengthening accountability, universities must therefore evaluate both technological availability and the conditions that allow students to use digital resources consistently, confidently and with academic purpose. An effective digital equity agenda must connect outcome governance with curriculum design, academic support and measurable student outcomes instead of treating it as an isolated information technology responsibility.

An outcome-focused interpretation demonstrates that outcome governance must be interpreted together with the institutional and social conditions surrounding students. Within higher education in emerging economies, outcome governance develops through uneven infrastructure, household resources, institutional capability and the growing expectation that students will manage essential academic activity through digital systems. The key distributional question is whether institutions can

identify who participates, who benefits and where digital disadvantage persists. Studies across tertiary environments show that input-focused metrics and weak accountability can turn formally universal digital provision into materially unequal learning conditions (Katz et al., 2021; Katz et al., 2025). This difference deserves attention because formal access to a platform does not ensure meaningful participation, and participation does not necessarily yield comparable educational opportunity. Within outcome based digital equity governance strengthening accountability, students with greater financial, social and technological resources can often buffer disruption through purchasing data, replacing devices, seeking private assistance or changing study locations, while resource-constrained learners possess fewer ways to compensate. Within outcome based digital equity governance strengthening accountability, accordingly, digital inequality operates as an unequal conversion process in which similar technologies produce different academic possibilities depending on the resources surrounding each learner. Within outcome based digital equity governance strengthening accountability, universities should assess access together with the practical conditions that determine whether digital tools can be used repeatedly, effectively and purposefully. A robust institutional equity approach needs to connect outcome governance with curriculum design, academic support and measurable student outcomes instead of treating it as an isolated information technology responsibility.

6.0 CONCLUSION

Contemporary digital inequality has become a central condition shaping educational opportunity because higher education now depends on sustained access to devices, connectivity, platforms, information and increasingly AI-supported learning tools. The analysis developed here shows that inequality remains cumulative. Material access influences whether students can participate consistently; digital skills influence the quality and autonomy of that participation, patterns of use determine how technology is mobilised for learning, and social position affects the resources available to recover from disruption. The third-level divide then appears in unequal outcomes; including achievement, persistence, belonging and readiness for further opportunity. Evidence from emerging-economy settings demonstrates that expanding connectivity can reduce one barrier while leaving affordability; skills, rural disadvantage and institutional capability unresolved (Clamor & Saloma, 2023; Subramaniam et al., 2024). Contemporary digital inclusion should therefore be judged by the educational capabilities students acquire and the outcomes they can realistically pursue, not simply by whether institutions have adopted contemporary platforms or increased the number of connected users.

The conceptual contribution rests in positioning digital inequality as an educational conversion problem rather than a narrow infrastructure deficit. Technology becomes opportunity only when students possess the material; cognitive, social and institutional conditions needed to transform access into purposeful academic action. This interpretation explains why identical digital systems can produce divergent experiences across income groups; rural and urban locations, genders and institutions. It also clarifies the role of universities: they cannot remove every external inequality; but they can reduce the extent to which those inequalities are amplified by course design, assessment practices, support arrangements and technology choices. Strategic responses should combine resilient access ecosystems; curriculum-embedded digital and AI literacy, targeted support for intersecting disadvantage, low-friction learning design and outcome-based equity governance. These measures are mutually reinforcing. Access without capability limits effective use; capability without

inclusive design restricts participation, and inclusive design without governance makes persistent gaps difficult to detect or correct.

Across emerging economies, the longer-term policy challenge is to ensure that digital transformation expands the distribution of educational possibility rather than modernising the mechanisms through which disadvantage is reproduced. Universities; public agencies and technology providers need shared measures that track affordability, reliability, capability, participation and outcomes across meaningful student groups. Research should also move beyond temporary crisis conditions and examine how generative AI; mobile-first learning, platformisation and changing labour-market expectations create new forms of digital advantage. The evidence base will be stronger when longitudinal and comparative studies identify which combinations of infrastructure; pedagogy and targeted support produce durable improvements for students who begin with fewer resources. A digitally advanced higher education system remains not necessarily an equitable one. Equity emerges when technological change increases students' real capacity to participate; learn, progress and convert education into wider life opportunities. Contemporary digital inequality will remain an educational problem until the benefits of digital higher education become attainable across social and geographic boundaries, rather than concentrated among those already best positioned to capture them.

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2. Conflict of Interest

The authors declare that there are no financial, professional, personal, or institutional interests that could have influenced the conceptual development, interpretation, or presentation of this article. No competing interests or relationships exist that could reasonably be perceived as affecting the objectivity, academic integrity, or scholarly independence of the work.

3. Author Contribution Statement

Muhammad Amran: Conceptualization, development of the conceptual framework, literature synthesis, analysis of digital inequality and educational opportunity perspectives, preparation of the original manuscript, and manuscript revision.

Mohamed Suhaimi Yusof: Conceptual development, theoretical interpretation, critical analysis, validation of the scholarly arguments, supervision, critical review, and manuscript editing.

Both authors contributed substantially to the intellectual development and refinement of the article, critically reviewed the manuscript for academic quality and coherence, and approved the final version for publication.

4. Ethics Statement

This article is a conceptual study based exclusively on published scholarly literature and secondary academic sources. It did not involve human participants, surveys, interviews, experiments, interventions, personal data collection, or access to confidential individual information. Accordingly, institutional ethical approval and

informed consent were not required. The article was developed in accordance with established principles of academic integrity, responsible scholarship, and appropriate acknowledgement of intellectual contributions. All sources used in developing the conceptual arguments were appropriately cited and interpreted within their relevant scholarly contexts. The authors take responsibility for the integrity, accuracy, and academic presentation of the work..

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