

Foundational AI Literacy in Under-Resourced South African Schools: Baseline Orientations and Learner Reflections After a Low-Infrastructure Workshop

Dhayanandhi Rita Govender*, Wynand Goosen

Swiss Institute of Management and Information, Randburg, South Africa

DOI: <https://doi.org/10.51583/IJLTEMAS.2026.150900139>

Received: 28 September 2026; Accepted: 03 October 2026; Published: 22 October 2026

ABSTRACT

Background and objectives: Foundational artificial intelligence (AI) literacy is fast becoming essential to education and work, yet learners in under-resourced schools may have limited access. This feasibility study examined whether a low-infrastructure AI literacy workshop could be delivered to Grade 11 public school learners in Gauteng, South Africa, and described learners' baseline AI-related orientations and their immediate responses and reflections after the workshop.

Methods: The study adopted a pragmatic, convergent mixed-methods design. We recruited Grade 11 learners from under-resourced public schools in the Johannesburg South education district through purposive and convenience sampling. They attended a three-hour, facilitator-led workshop which did not require individuals to have digital devices. We administered anonymous paper questionnaires before the workshop ($n = 237$; three single-item self-report indicators) and after it ($n = 220$; structured evaluation items and open-ended questions). Baseline items were analysed using descriptive statistics, one-sample t-tests against the scale midpoint, and Pearson correlations; open-ended responses were analysed thematically.

Results: Before the workshop, mean ratings for perceived AI clarity ($M = 3.61$, $SD = 0.992$), relevance to tertiary education ($M = 3.80$, $SD = 0.796$), and relevance to work ($M = 4.17$, $SD = 0.795$) all exceeded the neutral midpoint ($p < .001$). After the workshop, 211 learners (95.9%) reported greater motivation to study for their next examinations, and 218 (99.1%) reported motivation for Grade 12. Open-ended responses described aspirations, career thinking, and agency, alongside structural barriers such as limited access to devices and connectivity. Because the anonymous samples could not be matched, the baseline ratings are not meant to measure workshop effects.

Conclusions: The workshop proved feasible to deliver in low-resource conditions and received positive immediate feedback. The findings support further, more rigorous testing of low-infrastructure AI literacy provision, but do not establish gains in AI knowledge, causal effects, or lasting behavioural change.

Keywords: AI literacy; digital divide; secondary public school education; learner agency; South Africa

INTRODUCTION

Artificial intelligence (AI) has rapidly evolved from a specialised technological domain to an increasingly pervasive component of education, employment, communication, and everyday decision-making. Advances in machine learning, automated decision systems, and, particularly, generative AI have accelerated AI's integration into environments which were previously accessible to specialists. Contemporary AI systems can now generate text, images, code, and analytical outputs; provide personalised feedback; and serve as interactive learning and productivity tools. This expansion has shifted the educational challenge from preparing a small number of future programmers and data scientists to preparing a much broader population to live, learn and work in AI-mediated environments (Long & Magerko, 2020; Ng et al., 2021).

The rapid diffusion of generative AI has intensified this requirement. Inaccurate outputs, over-reliance, academic-integrity concerns, privacy risks, bias, and reduced learner autonomy make operational proficiency insufficient. Responsible use also requires judgement on when AI is appropriate, how outputs should be evaluated and when human reasoning should remain primary (Miao & Holmes, 2023; UNESCO, 2024). This broader understanding aligns with the highly influential conceptualisation by Long and Magerko (2020), who define AI literacy through competencies that enable individuals to understand, critically evaluate, communicate about, and interact effectively with AI. Ng et al. (2021) subsequently consolidated AI literacy into four interconnected dimensions: knowing and understanding AI, using, and applying AI, evaluating, and creating with AI, and addressing ethical issues. Together, these studies demonstrate that AI literacy is not merely a new form of computer literacy; it combines conceptual knowledge, application, critical judgement, and ethical awareness.

The changing labour market and the educational landscape make AI an urgent educational requirement. The World Economic Forum (2025) estimates that about 39% of workers' core skills will change by 2030 and identifies AI, big data, and technological literacy as among the fastest-growing areas of demand. Analytical thinking, creativity, resilience, flexibility, curiosity, and lifelong learning also remain important, so AI literacy has both technological and human-capability dimensions.

The educational implications are particularly significant for learners approaching the transition from school to tertiary education or employment. AI may change occupational tasks faster than conventional career guidance systems can update static descriptions of occupations. Learners must therefore increasingly understand not only which jobs exist, but also how AI may augment, restructure, or create occupational roles. This requires what may be termed **AI-related future readiness**: the ability to recognise technological change, interpret its implications for study and work, identify the skills required to adapt, and perceive oneself as capable of participating in that environment.

These challenges are particularly significant in South Africa. Statistics South Africa (2026) reported an official unemployment rate of 33.6% in the first quarter of 2026. Learners approaching the labour market must therefore prepare for technological change in a constrained employment environment.

The risks of this transition are unevenly distributed. South African public schooling remains characterised by substantial disparities in infrastructure, digital access, teacher preparedness, and exposure to educational technologies. Recent South African scholarship emphasises that educators and learners require more than technological access to engage safely and meaningfully with AI (Cross & Feldman, 2025). Schools' unequal capacity to provide AI-related learning may therefore create new educational stratification on top of existing inequalities.

The present study illustrates this challenge empirically. Almost one-quarter of participating learners (24.9%) reported not owning a smartphone. Importantly, none of the participating learners were enrolled in an IT or Computer Applications Technology subject in Grade 11, indicating that participants had no formal technology subject in their Grade 11 programme. Access therefore represents only one layer of inequality. A learner may possess a smartphone yet have little understanding of how AI systems operate, how to evaluate algorithmic outputs, how AI may affect future occupations, or how to use AI responsibly in learning. An emerging **AI capability divide** may therefore distinguish not only those who can access AI technologies from those who cannot, but also those who possess the knowledge and agency to evaluate and benefit from them from those who remain primarily passive users or are excluded altogether.

International scholarship increasingly supports introducing AI literacy before higher education. Casal-Otero et al. (2023), reviewing 179 K-12 publications, found growing activity, substantial variation in curriculum design, and limited rigorous evaluation. Wang and Lester (2023) similarly call for evidence-based K-12 AI learning, curriculum integration, teacher development, and assessment. UNESCO's (2024) student framework organises twelve competencies across a human-centred mindset, ethics, AI techniques and applications, and AI system design.

Despite this growth, important gaps remain. Much of the empirical evidence on AI in education has emerged at the higher-education level (Crompton & Burke, 2023), while comparatively little empirical attention has been directed to how foundational AI literacy should be introduced in secondary schools, particularly in contexts where infrastructure, teacher expertise and learners' prior exposure cannot be assumed. The geographic-

hical distribution of the evidence compounds this gap. Much of the AI-literacy literature has developed in technologically advanced or comparatively well-resourced educational systems. Research on AI implementation in schools in the Global South remains less mature, even though infrastructure and technological exposure inequalities may make AI literacy particularly consequential in these contexts.

Recent South African scholarship has begun to address this problem. Cross and Feldman (2025) argue that South African schools cannot realistically avoid engaging with AI and emphasise the need for explicit preparation for the opportunities, risks, privacy implications, and responsible use of AI. A scoping review of AI integration in primary and secondary schools likewise found that, although AI may support personalised and inclusive learning, infrastructure deficiencies are a major barrier in South Africa, and effective use requires educators to develop technical skills and an understanding of AI ethics (Saal et al., 2025). South Africa has also begun an important process of strengthening computational education through the Coding and Robotics Curriculum and Assessment Policy Statement (Department of Basic Education, 2024). Yet the Department of Basic Education has explicitly acknowledged that the costs of educator development, digital infrastructure, and ongoing technological support make universal, mandatory implementation impractical in the short term. It has adopted a progressive implementation approach, beginning with primary schools where capacity exists, from 2026 (Department of Basic Education, 2025).

Grade 11 public school learners occupy a uniquely urgent position in this landscape. They cannot wait for reforms that begin in the Foundation Phase to work their way through the education system. Within about a year, they will complete secondary school and decide on university, further education and training, employment, and career direction. Their educational preparation therefore occurs at the intersection of two realities: an existing curriculum designed before the rapid mainstreaming of generative AI, and a labour market in which AI-related capabilities are increasingly relevant.

The study examines a brief, facilitator-led AI literacy workshop for Grade 11 learners in resource-constrained public schools. It documents learners' self-reported AI-related perceptions before the workshop and their immediate feedback afterward. The study therefore addresses feasibility and learner perceptions; it does not measure AI literacy or the workshop's effectiveness. The data can inform the design and evaluation of future low infrastructure provision but cannot establish that this workshop developed knowledge or agency.

The article therefore advances a specific proposition: **educational systems should not make foundational AI literacy conditional on achieving technological parity between well-resourced and under-resourced schools.** If AI literacy is increasingly necessary for educational and occupational participation, delaying exposure until ideal infrastructure is in place may reproduce the very inequalities that digital and AI education are intended to address. This proposition is argued from the literature and the South African context; the present data do not test it.

Accordingly, the study addresses the following overarching research question:

What do baseline AI-related perceptions and immediate post-workshop feedback indicate about the feasibility of a low-infrastructure AI literacy workshop for Grade 11 learners in resource-constrained South African public schools?

Three associated questions guide the analysis:

- How do learners rate their understanding of AI and its anticipated relevance to education and work before the workshop?

- What do learners report after the workshop regarding its relevance to academic motivation, tertiary aspirations, career thinking, and personal agency?
- What implications do these findings have for developing a contextually appropriate and scalable AI literacy intervention for the South African secondary-school curriculum?

Ai Literacy, Inequality and Future Readiness

From Digital Literacy to AI Literacy

Digital literacy traditionally refers to an individual's ability to access, interpret, evaluate, and use digital information and technologies. AI literacy extends this requirement. An individual can be digitally competent yet remain poorly prepared to understand how automated systems generate outputs, how algorithms use data, why AI may produce inaccurate or biased results, or how AI can alter occupational roles.

Long and Magerko (2020) argue that AI literacy comprises competencies that enable people to critically evaluate AI technologies and interact with them effectively. This conceptualisation matters because it shifts AI literacy away from a narrow focus on programming. Ng et al. (2021) likewise demonstrate that AI literacy encompasses conceptual understanding, application, evaluation, creation, and ethics, a multidimensional framework that has become foundational in the field.

This broader interpretation is particularly appropriate for secondary-school learners. Most Grade 11 learners will not become AI developers, but all are likely to encounter AI across education, recruitment, financial services, customer interactions, healthcare, communication, administration, and numerous occupational settings. Foundational AI literacy should therefore be increasingly regarded as a form of general educational preparedness. UNESCO's (2024) framework reinforces this position by treating AI competencies as relevant to responsible citizenship rather than to technical occupations alone, emphasising human agency, ethical judgement, foundational knowledge, and creative participation.

AI Education at School Level

The international evidence based on school AI literacy is growing but remains uneven. Casal-Otero et al. (2023) identified substantial practical and conceptual activity, while Wang and Lester (2023) cautioned that K-12 curriculum, pedagogy, and assessment still require a stronger empirical foundation. Both sources support interdisciplinary, competency-based learning adapted to school contexts.

This contextual qualification is crucial. An AI curriculum designed for a school where every learner has a laptop, stable broadband connectivity, specialist teachers, and technical support cannot simply be transplanted into a school facing device shortages, intermittent connectivity and competing basic educational priorities. The pedagogical question is therefore not merely what learners should know about AI. It is also how AI literacy can be taught equitably where the technological conditions normally assumed by AI education are absent.

South African Educational Inequality and the AI Divide

South Africa's digital education environment reflects its broader socio-economic inequality. Access to technology varies markedly across communities, institutions, and households. Even where connectivity exists, disparities persist in device quality, data affordability, teacher preparedness, exposure to advanced digital tools and opportunities for meaningful use of technology.

Recent South African research on teachers' preparedness for AI integration underscores the importance of this context. Ayanwale et al. (2024), in a study of 430 South African in-service teachers, found that technology integration, social influence, attitudes, and perceived self-efficacy shaped teachers' preparedness to integrate AI into schooling. Research on Coding and Robotics likewise cautions that curriculum

innovation cannot be separated from teacher preparation, infrastructure, and educational equity (Tshidi & Dewa, 2024).

This suggests that simply including AI content in a curriculum does not guarantee meaningful AI literacy. Implementation must consider whether teachers are prepared, whether learners have access, whether the material is understandable, whether it is culturally and linguistically appropriate, and whether the educational design can function in low-resource conditions.

A useful distinction, therefore, is between technology-dependent AI education and AI literacy education. The former may require devices, programming environments, data, specialised software, or robotics infrastructure. Foundational AI literacy can begin at a more conceptual level: understanding what AI is, where it is used, how it influences decisions, what it can and cannot do, how occupations may change, how humans can work with AI, and why ethical judgement remains necessary. This distinction informed the intervention examined in this study.

Future Readiness and Learner Agency

AI readiness involves more than cognitive knowledge. Learners may understand that AI exists yet still believe that technological careers, higher education, or digitally intensive occupations are inaccessible to them. Educational preparedness therefore has both cognitive and affective dimensions.

Social Cognitive Theory emphasises the relationships among self-efficacy, the environment, behaviour, and outcome expectations (Bandura, 1997). For learners considering future pathways, beliefs about what they can do can shape the opportunities they pursue. Consequently, interventions aimed at future readiness should address not only information deficits but also perceptions of agency. This is particularly relevant in environments characterised by historical exclusion. If advanced technology is perceived as belonging to other schools, communities or social groups, a lack of confidence may become an additional barrier, even when educational opportunities become available.

The intervention therefore incorporated not only introductory AI knowledge and career information but also psychologically oriented elements addressing self-belief, problem-solving, and responses to technological change. The pedagogical framework underpinning the intervention combined constructivist learning, social-cognitive principles and selected cognitive-behavioural elements.

RESEARCH METHODOLOGY

Research Design

The study employed a pragmatic, convergent, mixed-methods design for feasibility and orientation, combining quantitative single-item indicators with qualitative open-ended responses (Creswell & Creswell, 2018; Creswell & Plano Clark, 2018). The design addressed an applied question: whether foundational AI concepts and future-oriented reflection could be introduced within the practical constraints of under-resourced public schools.

The quantitative component was descriptive and non-experimental. The study collected 237 pre-workshops and 220 post-workshop questionnaires. Responses were anonymous and could not be matched to individuals; the study had no comparison group. The three AI ratings and their one-sample tests were drawn from the pre-workshop instrument. The 220-person evaluation and open-ended responses provide immediate post-workshop feedback. Neither strand estimates intervention effects.

The one-sample tests compare pre-workshop ratings with the neutral midpoint of the response scale, rather than with post-workshop responses. The two questionnaire samples have different denominators. The analysis therefore distinguishes baseline orientation from learner feedback and avoids causal claims (Shadish et al., 2002).

To keep the claims within the limits of the design, this article distinguishes four terms throughout. Feasibility refers to whether the workshop could be delivered as planned in under-resourced schools without individual devices; this is the study's primary focus. Learner perceptions refer to learners' self-reported views, namely the three baseline ratings and the post-workshop evaluation and reflections; these are the only data the study measured. AI literacy refers to demonstrated competencies in understanding, using, evaluating, and engaging ethically with AI (Long & Magerko, 2020; Ng et al., 2021); the study did not measure it. Intervention effectiveness refers to measured, attributable changes in such competencies or in behaviour; the design cannot assess it.

Participants and Research Setting

The intervention was conducted with Grade 11 learners from public schools in under-resourced communities within the Johannesburg South district of the Gauteng Department of Education (GDE), Gauteng Province, South Africa. In South Africa, public schools are state schools administered by provincial education departments, unlike independent (private) schools. A combined purposive and convenience sampling strategy identified schools and participants who met the target population criteria and were able to participate. The study used public schools in Gauteng that agreed to participate.

The study obtained 237 pre-workshop questionnaires and 220 post-workshop evaluations. The three baseline AI items had no missing cases ($N = 237$); the one-sample tests therefore have $df = 236$ and the correlation tests $df = 235$. The post-workshop evaluation comprised 220 respondents.

The participant profile reflects the study's infrastructural constraints. Approximately 24.9% of learners reported they did not own a smartphone, and no participant was enrolled in an IT or Computer Applications Technology subject. The cohort was predominantly female (70.9%), with a modal age of 17 years (46.0%). Prior to the workshop, 68.8% reported plans to attend university, and 71.3% agreed that AI would be used in future tertiary study.

The AI Literacy Intervention

The intervention consisted of a structured, three-hour facilitated workshop. Its purpose was not to teach programming or advanced machine learning, but to provide a foundational understanding of how AI is adopted in the world of work and in future-oriented contexts. The workshop covered three broad areas.

First, technological literacy introduced learners to concepts related to artificial intelligence and technological change. AI was explained through practical examples rather than advanced technical theory, including a brief, everyday introduction to AI and the Fifth Industrial Revolution.

Second, education and career readiness linked AI to tertiary education, occupations, and evolving labour-market requirements. Learners were introduced not only to specialist AI occupations but also to the broader possibility that existing professions would increasingly require interaction with AI-enabled systems.

Third, psychological preparedness and personal agency addressed confidence, limiting assumptions, problem-solving, and adaptability through elements of cognitive-behavioural frameworks. This component recognised that information about technological change can produce anxiety as well as opportunity, and that future readiness requires the ability to respond constructively to change.

The intervention was deliberately designed to remain functional without requiring every learner to have a digital device. We used shared demonstrations where available, and paper-based questionnaires and facilitator-led activities ensured that technological inequality did not become a barrier to participation.

Table 1 summarises the components, content, activities, and approximate duration of the intervention.

Table 1: Low-infrastructure AI literacy intervention

Component	Purpose and content	Activity and resources	Approx. time
AI foundations	Introduce everyday AI applications, data dependence, capabilities, and limitations.	Facilitator explanation, familiar examples, guided questions and paper-based prompts.	60 min
Education and careers	Connect AI with tertiary study, changing occupations, augmentation, and emerging skill requirements.	Career examples, facilitated discussion and learner reflection activities.	60 min
Ethics and agency	Address bias, privacy, academic integrity, confidence, adaptability, and problem-solving.	Short scenarios, discussion, personal reflection, and action planning.	60 min

Data Collection

The pre-workshop questionnaire included three single-item indicators. They describe baseline perceptions and are not validated multidimensional AI literacy scales:

- Perceived AI Clarity: learners' perceived clarity regarding artificial intelligence ("Learner is clear about what Artificial Intelligence is about").
- Perceived relevance to tertiary Education: learners' perceptions of AI's relevance to future tertiary learning ("Learner confirms Artificial Intelligence will be applied to tertiary studies").
- Perceived relevance to Work: learners' perceptions of AI's relevance to employment and the future workplace ("Learner confirms Artificial Intelligence will be used in the world of work").

Items were measured on five-point Likert-type scales (1 = Strongly Disagree to 5 = Strongly Agree).

Post-workshop evaluation questions and open-ended responses were collected from a separate set of 220 questionnaires. The structured evaluation covered perceived career relevance, workshop experience, motivation, and other immediate reactions. Qualitative responses addressed academic motivation, tertiary aspirations, career thinking, and personal development.

Data Analysis

Descriptive statistics were computed for the three pre-workshop items, followed by one-sample t tests against the scale midpoint of three and Pearson correlations among the items. Post-workshop frequencies use the 220-response denominator. No individual pre/post comparisons were possible.

The t-tests establish that baseline response means exceeding the neutral scale point; they do not measure workshop improvement. Table 2 presents the aggregate baseline results.

Open-ended responses were analysed using Braun and Clarke's (2006) six-phase thematic approach: familiarisation with the data, generating initial codes, searching for themes, reviewing themes, defining, and naming themes, and producing the report. The quotations reported below illustrate the themes rather than indicate their prevalence among all 220 evaluation respondents.

Ethics

The study received ethical approval from the Swiss Institute of Management and Innovation (SIMI) and research approval from the Gauteng Department of Education (GDE) (approval no. 2024/348; reference 8/4/4/1/2; 3 September 2024) for research in secondary public schools in the Johannesburg districts (Govender, 2026). The GDE approval letter was presented to the principal of each school, and written

consent from the principal was a condition of each school's inclusion (Govender, 2026). Because all participants were minors, parents and guardians were informed of the study through the school principals, and the researchers obtained written parental or guardian consent and learner assent before participation. Learners and their parents or guardians were informed of the study's purpose, the protection of learners' anonymity, and the right to withdraw at any time without penalty (Govender, 2026). Participation was voluntary, and learners received no payment and incurred no costs. Learner names and identifying school details were not linked to survey responses, data were anonymised before analysis, and raw data were stored with password protection in compliance with the Protection of Personal Information Act (Govender, 2026).

FINDINGS

Perceived relevance to work

The pre-workshop AI clarity item had $M = 3.61$ ($SD = 0.992$; $Mdn = 4$). Its meaning exceeded the neutral response of 3, $t(236) = 9.49$, $p < .001$ (Table 2). This indicates a positive baseline self-rating of clarity, not an outcome of the workshop. These baseline responses cannot show that AI clarity increased. The result also reflects perceived understanding, not demonstrated knowledge. The workshop evaluation and learner comments are examined separately below.

Table 2: Pre-workshop single-item ratings against the neutral midpoint of 3 ($N = 237$; $df = 236$)

Construct	M	SD	t	p
Perceived AI clarity	3.61	0.992	9.49	< .001
Perceived relevance to tertiary education	3.80	0.796	15.50	< .001
Perceived relevance to work	4.17	0.795	22.63	< .001

Note. Items were rated from 1 (Strongly Disagree) to 5 (Strongly Agree). No post-workshop scores on these items are available for a paired comparison.

Baseline Perceived Relevance to Education

Before the workshop, learners rated AI's anticipated relevance to tertiary education at $M = 3.80$ ($SD = 0.796$; $Mdn = 4$), above the neutral midpoint, $t(236) = 15.50$, $p < .001$. This is a single baseline perception, not evidence of improved educational readiness. This is important because AI preparedness at the secondary-school level should not be limited to occupational choice. Learners entering universities, colleges and vocational institutions are increasingly likely to encounter AI-enabled tutoring, automated feedback, learning analytics, and AI-supported professional tools. Awareness before transition may therefore be part of broader post-school preparedness.

Baseline Perceived Relevance to Work

The pre-workshop work item had $M = 4.17$ ($SD = 0.795$; $Mdn = 4$), $t(236) = 22.63$, $p < .001$. Learners entered the workshop expecting AI to matter in work. The measure does not assess occupational competence or workshop effects.

This finding aligns with the broader global labour-market discourse. The World Economic Forum's Future of Jobs Report 2025 identifies AI and big data as among the fastest-growing technological skill areas and forecasts extensive occupational and skills transformation by 2030 (World Economic Forum, 2025). For secondary education, career guidance based largely on static job descriptions may increasingly be insufficient. Learners need to understand how occupations evolve and how combinations of technological competence and human capability may shape employability.

Associations among Baseline Perceptions

The three pre-workshop items were positively correlated: AI clarity and education, $r = .299$; AI clarity and work, $r = .379$; education and work, $r = .428$ (all $p < .001$; $df = 235$). These relationships reflect baseline perceptions only. They do not establish that the workshop aligned the items or developed multidimensional competence.

Post-workshop Evaluation and Academic Motivation

Among the 220 post-workshop evaluation respondents, 211 (95.9%) answered Yes to being motivated to study harder for their next examinations, and 218 (99.1%) answered Yes to being motivated for Grade 12.

These figures are immediate self-reports, not measured changes in study behaviour. Open-ended responses described perceived competition for tertiary places, the value placed on marks, and feelings of hope. Such comments help interpret how the workshop was received, but their frequency and persistence cannot be inferred from selected quotations.

Tertiary Aspirations and Career Thinking

Qualitative analysis of responses to post-workshop questions about tertiary plans and career thinking identified four recurring themes: strengthened aspiration for tertiary education; awareness of academic requirements; need for information, knowledge, and guidance; and external support requirements. Some learners described clearer thinking about tertiary pathways, noting that the workshop provided “an opportunity and time to learn more about my future career” and increased their intention to “study further.” Several expressed understanding that academic performance is the primary gateway to opportunity: “I should pass Grade 11 and 12 with good marks” and “by passing with higher grades so I can enrol.” Others articulated barriers, including the need for financial support and the lack of technology: “Laptops in school and Wi-Fi for connecting” and “Content must be added to Life Orientation.” These responses indicate what some learners regard as the conditions required for AI-related learning to translate into educational and occupational opportunity; how widely these views were held was not quantified.

The intervention exposed learners to the idea that AI creates and transforms occupations rather than merely eliminating jobs, a distinction that is pedagogically important, given that public discussion about AI frequently oscillates between technological optimism and fear of mass displacement. The World Economic Forum (2025) estimates substantial job displacement and job creation through 2030, with significant redistribution across occupations and skills.

Personal Agency, Confidence and Reflection

The qualitative thematic analysis identified seven recurring themes in post-workshop responses: future aspirations and a success orientation; increased awareness of real-world expectations; personal empowerment and self-belief; inspiration drawn from learning about AI; improved academic mindset; responsibility and self-discipline; and personal reflection and shifts in thinking. The responses below illustrate how some learners described the workshop, not how widely these views were held. Under the theme of future aspirations, learners stated: “So I can be successful in life,” “Now I want to study further,” and “So that I can achieve my goals and dreams.” The personal empowerment theme included statements such as: “It gave me hope,” “I believe in me,” and “The workshop shows me to believe in myself.” Under the responsibility and self-discipline theme, learners noted: “I’m responsible for me” and “When I get those marks, I don’t blame anyone,” responses that express a sense of personal responsibility. The personal reflection theme yielded statements such as: “It might lead me to change how I think,” “It really made me think,” and “To know who I am and what I want in the future.”

Table 3 sets the baseline ratings alongside the post-workshop feedback and states the inference that each comparison permits. Because respondents cannot be linked across the two questionnaires, the comparison is descriptive only.

Table 3: Juxtaposition of baseline ratings and post-workshop feedback

Pre-workshop rating (N = 237)	Post-workshop reflection (N = 220)	Relationship	Permitted inference
Baseline AI clarity: M = 3.61	Learners described new awareness of AI and its everyday relevance.	Descriptive juxtaposition: respondents cannot be linked	Positive baseline clarity rating and later qualitative engagement; no measured gain.
Baseline tertiary relevance: M = 3.80	Responses emphasised study, marks, tertiary access, and the need for guidance.	Descriptive juxtaposition: respondents cannot be linked	Positive baseline expectation and later educational reflection; no measured change.
Baseline work relevance: M = 4.17	Responses connected AI with careers, employability, opportunity, and adaptation.	Descriptive juxtaposition: respondents cannot be linked	Strong baseline expectation and later career reflection; no measured change.
No matched pre/post scores	Some comments expressed hope and agency, while structural barriers such as devices, connectivity, and finance remained.	Descriptive juxtaposition: respondents cannot be linked	No individual change score or causal effect can be estimated.

The qualitative reflections suggest that a future AI literacy curriculum should address both conceptual understanding and learners' sense of agency. This is a curriculum proposition; the study did not measure change in these domains. Drawing on the cognitive and affective dimensions of readiness outlined in Section 2.4, three elements warrant testing in subsequent work:

- knowledge: understanding AI and its applications.
- orientation: recognising its relevance to education, work, and society; and
- agency: perceiving oneself as capable of learning, adapting, and participating.

DISCUSSION

AI Literacy as an Educational Equity Issue

The study indicates that a low-infrastructure workshop could be delivered in under-resourced schools and that learners' immediate feedback was positive. The pre-workshop ratings show that many learners already recognised AI's relevance before attending. These separate observations do not establish improved AI competence, but they help frame a more rigorous future evaluation.

Much discussion of educational technology begins with infrastructure: devices, connectivity, software licences, laboratories, and specialist teachers. These resources are important, particularly for advanced technological learning. However, if foundational AI literacy is made entirely conditional on achieving sophisticated technological infrastructure, disadvantaged learners may wait longest for the knowledge that is increasingly important to their educational and occupational decisions.

The study therefore suggests a layered implementation model. **Foundational AI literacy can begin before advanced AI infrastructure is universally available.** Learners can be introduced to AI concepts, applications, limitations, ethics, occupational implications and human-AI collaboration through facilitated

activities, discussions, case examples, videos where available, paper-based materials and shared technological demonstrations. More advanced stages can progressively introduce generative AI use, coding, data literacy, machine learning, and robotics, as resources permit.

From the Digital Divide to the AI Capability Divide

Read alongside the literature, the participant profile suggests that educational policy may need to broaden its understanding of the digital divide. Device ownership and connectivity remain important; in this study, almost one quarter of baseline participants reported they did not own a smartphone. But access alone does not confer capability. A learner may have a smartphone yet still be unable to evaluate AI output, identify hallucinated information, understand algorithmic bias, use generative AI ethically, or recognise how AI may affect occupational choices.

The emerging inequality is therefore increasingly a capability divide, encompassing differences in access to technology, exposure to AI, understanding of AI, ability to use AI, critical evaluation of AI, ethical awareness, confidence and agency, and access to educational and career guidance on AI. Ng et al.'s (2021) multidimensional conceptualisation of AI literacy precisely supports this broader interpretation. UNESCO's (2024) framework similarly treats AI competence as encompassing knowledge, ethics, human agency, and creative participation rather than merely operational technical skill. Equitable AI education consequently requires more than distributing devices; it requires deliberate capability development.

The Significance of Grade 11

Selecting Grade 11 is strategically important. At this stage, learners are approaching the final year of school and increasingly making decisions about university, vocational education, employment, and career direction. Yet learners currently in Grade 11 cannot benefit retrospectively from curriculum reforms that begin in the Foundation or Intermediate Phase and take several years to work through the system. The Department of Basic Education's progressive introduction of Coding and Robotics is an important development, but its staged implementation means that older secondary learners require complementary interventions now. The Grade 11 year therefore constitutes a potentially high-leverage intervention point.

Life Orientation as a Curriculum Vehicle

A major practical implication concerns where AI literacy might be located within the existing curriculum. Creating a new compulsory AI subject would entail significant requirements, including curriculum development, teacher qualifications, assessment design, timetable, infrastructure, and funding. Such reform may ultimately be appropriate, but it is not the only implementation route.

Life Orientation already addresses dimensions of personal development, citizenship, study, careers, and preparation for life beyond school. This study therefore proposes Life Orientation as a practical curricular home for foundational AI literacy, a proposal echoed in learners' qualitative responses, including one stating that "Content must be added to Life Orientation." The proposal should not be interpreted as turning Life Orientation into a computer science subject. Rather, AI literacy could be integrated into existing themes, including career and career choice, tertiary education, study and lifelong learning, workplace readiness, responsible citizenship, ethics, personal development, decision-making and the changing social and economic environment. A foundational Grade 11 AI literacy component could consequently address questions such as: What is AI? Where do learners already encounter it? What can AI do well and poorly? How might AI change different occupations? Which human capabilities remain important? How can AI support learning without replacing it? What constitutes responsible and ethical AI use?

AI Literacy Should Combine Technical and Human Capabilities

Learners' positive self-reported responses to the intervention's career and motivational components are consistent with a broader point about curriculum design. AI education is sometimes framed as a competition between human and machine capabilities. Future-of-work literature offers a more nuanced picture:

technological capabilities are becoming increasingly important, yet human capabilities remain central. The World Economic Forum (2025) identifies analytical thinking, resilience, flexibility, agility, leadership and creative thinking alongside AI and big-data skills. An effective school-level AI literacy curriculum should therefore avoid two extremes: technical reductionism, where AI literacy becomes only coding or technical operation; and generic futurism, where learners hear broad claims about “the jobs of tomorrow” without acquiring any concrete understanding of AI. A stronger model integrates: **AI knowledge + critical thinking + ethics + adaptability + career understanding + personal agency.**

Teacher Preparedness and Facilitator-Supported Implementation

A possible objection to curriculum integration concerns teacher capacity. Recent South African evidence indicates that teacher preparedness for AI is uneven and shaped by confidence, experience with technological integration, attitudes, and institutional support (Ayanwale et al., 2024). This supports a staged rather than an idealised implementation approach. AI literacy need not begin with every Life Orientation teacher becoming an AI specialist. Initial implementation could draw on standardised workshop packages, facilitator guides, teacher micro-credentials, video-supported delivery, train-the-trainer programmes, district-based specialist support, partnerships with universities and professional bodies, reusable learner workbooks, and progressively updated digital resources.

The Value of Low-Infrastructure Design

The low-infrastructure dimension of the intervention is one of its strongest practical contributions. South African educational technology policy must operate within uneven reality. A national model that functions only under ideal conditions risks reproducing inequality. This article explicitly advances low-tech resilience, multilingual flexibility, and cultural anchoring as principles for scalable AI literacy education: core learning outcomes should remain achievable even where individual device access or connectivity is limited. That principle may have relevance beyond South Africa to other resource-constrained education systems. The model may be transferable to other low-resource and Global South settings where device ownership, connectivity and specialist teacher supply are uneven. Transfer is conditional rather than automatic: adaptation should consider language, curriculum location, facilitator capacity, cultural examples, data protection, local labour-market information, and access to post-school pathways. The contribution is therefore a design proposition for context-sensitive feasibility, not a universal programme-effect estimate.

A Proposed Framework for Foundational Ai Literacy

Drawing mainly on the literature reviewed in Section 2, and informed in a preliminary way by learners' reflections, the study proposes organising school-level foundational AI literacy around six interconnected components. Table 4 shows how each component relates to established emphases in the literature and how it is extended for the South African context. The framework is a conceptual proposal for future testing, not a model validated by the present data.

Table 4: Proposed context-sensitive framework for foundational AI literacy

Established emphasis on the literature	Framework component	Context-specific extension
Understand AI concepts and capabilities (Long & Magerko, 2020; Ng et al., 2021)	Understand	Low-infrastructure entry routes and shared or paper-supported learning.
Use and apply AI (Ng et al., 2021)	Apply	Purposeful use of accessible tools, progressing from shared demonstrations to individual use as resources permit.
Critically evaluate outputs and limitations (Long & Magerko, 2020; UNESCO, 2024)	Evaluate	Attention to misinformation, hallucination, and uneven access.

Ethics and responsible participation (Ng et al., 2021; UNESCO, 2024)	Act ethically	School-level treatment of privacy, integrity, fairness, and human oversight.
K-12 curriculum, teacher development, and assessment (Wang & Lester, 2023)	Navigate education and work	Career guidance for near-term post-school transitions in unequal labour markets.
Human agency and sociocultural context (UNESCO, 2024; Wang & Lester, 2023)	Develop agency	Explicit self-efficacy, adaptability, and participation for historically excluded learners.

Understand

Learners require a basic conceptual understanding of AI, including what it is, common applications, the role of data, differences between human and machine capability, and the limitations of AI-generated outputs.

Apply

Learners should progressively develop the ability to use accessible AI tools for educational and everyday tasks. Application should emphasise purposeful use rather than passive consumption.

Evaluate

Learners need critical literacy concerning accuracy, bias, hallucination, misinformation, privacy, algorithmic decision-making, and the reliability of AI outputs.

Act Ethically

AI literacy should address academic integrity, privacy, intellectual property, fairness, discrimination, accountability, and responsible human oversight.

Navigate Education and Work

Learners should understand how AI may affect higher education, occupations, entrepreneurship, and workplace practice. Career guidance should explain both technological displacement and augmentation.

Develop Agency

Learners should be encouraged to see themselves as active participants rather than passive recipients of technological change. Adaptability, confidence, problem solving, lifelong learning and self-directed development should be explicit outcomes.

These components can be represented conceptually as:

Understand → Apply → Evaluate → Act Ethically → Navigate → Develop Agency

The progression need not be strictly linear. Rather, the six dimensions interact to develop future-ready AI capability.

Implications for Policy and Practice

Read alongside the literature, the findings suggest several considerations for South African education policy. These are proposals for further testing rather than conclusions established by this study.

First, AI literacy should be treated as a general educational competency rather than a specialist technological elective. Not every learner requires advanced coding, but every learner is increasingly likely to interact with AI.

Second, Grade 11 warrants specific attention as an immediate intervention population. Current learners should not have to wait for earlier-grade curriculum reforms to progress through the schooling system.

Third, Life Orientation provides a viable platform for initial integration because it already addresses careers, study, personal development, and preparation for society and work, and some learners identified it as a home for AI content.

Fourth, implementation should be distinguished between foundational AI literacy and advanced technical AI education. The former can be introduced with comparatively modest infrastructure, while the latter expands alongside Coding and Robotics, ICT capacity, and teacher development.

Fifth, teacher development should accompany curriculum integration. Short-form teacher development, facilitator certification or micro-credentials may provide a practical mechanism for rapidly increasing delivery capacity.

Sixth, AI literacy resources should be designed for unequal educational conditions, offering both connected and low-connectivity implementation routes rather than assuming a single technological environment.

Seventh, curriculum content will require regular updates. Unlike conventional curriculum areas that may remain comparatively stable for several years, AI is evolving rapidly. Governance arrangements should therefore permit periodic revision without requiring complete curriculum redesign.

Finally, AI literacy should be connected to broader career guidance. Learners need practical information about changing occupations, emerging study pathways, interdisciplinary careers, and the skills that complement AI.

LIMITATIONS

Several limitations require recognition. The most important concern is research design. Although questionnaires were administered before and after the intervention, anonymity prevented matching individual responses. Paired-sample analysis was therefore impossible, and the study cannot establish measured individual change from baseline to post-intervention (Shadish et al., 2002).

Second, the design lacks a matched pre/post assessment or comparison group. Baseline ratings should not be interpreted as outcomes, and positive workshop feedback cannot be causally attributed to the intervention.

Third, several important outcomes, including academic motivation, were based on learners' self-reports rather than subsequent observation of academic behaviour or examination performance.

Fourth, schools and participants were selected using purposive and convenience considerations within the GDE's Johannesburg South district. Findings should therefore not automatically be generalised to all South African schools.

Fifth, the three AI ratings were measured at baseline, while immediate post-workshop responses captured perceived motivation and reflection. The study did not measure post-workshop AI knowledge on a comparable instrument or long-term retention.

Sixth, the three baseline measures were single-item indicators of perceived clarity and relevance. They are not validated multidimensional AI literacy scales, and their reliability cannot be estimated from single items.

Seventh, post-workshop responses were collected immediately after the workshop, which the researcher also facilitated, so they may be influenced by social desirability and the novelty of the experience.

Eighth, technological change may quickly alter the content considered appropriate for foundational AI literacy. Curriculum design must therefore remain adaptive.

These limitations do not negate the value of the findings. They establish the appropriate scope of the claims: the study provides indicative evidence of feasibility, learner engagement, baseline orientation, and post-workshop feedback, rather than definitive experimental evidence of causal effectiveness.

FUTURE RESEARCH

The study creates several opportunities for further empirical investigation.

A future evaluation should employ anonymised unique identifiers that allow individual pre- and post-intervention responses to be matched while maintaining confidentiality, for example, a self-generated code that each learner creates from non-identifying personal details, permitting direct measurement of change.

A randomised, matched-comparison or waitlist-control design would allow stronger causal assessment.

Longitudinal research should follow learners into Grade 12 and beyond to investigate whether AI literacy interventions influence subject performance, tertiary applications, programme selection, occupational aspirations, or actual employment trajectories.

Research should also compare different intervention durations and delivery models. A three-hour workshop may provide foundational exposure, but a sequence of shorter modules across the academic year may produce greater retention.

Gender-related patterns warrant examination. The current cohort was 70.9% female, yet participation in AI-related education and occupations remains uneven internationally. Whether the intervention's effects differ by gender deserves specific investigation.

Comparative provincial studies would help determine how differences in language, infrastructure, urbanisation, and school context affect intervention outcomes.

Teacher-focused research is also required. Learner curriculum integration will ultimately depend on teachers' confidence, knowledge, and ability to facilitate responsible AI learning.

Finally, future evaluations should measure AI literacy directly rather than through perception items. This could combine a validated multidimensional instrument, such as the 32-item AI Literacy Questionnaire developed for secondary students (Ng et al., 2024), adapted and validated for South African learners, with objective knowledge tests and short performance tasks, for example evaluating an AI-generated answer for accuracy and bias. Because validated questionnaires remain self-report measures, pairing them with objective tasks would allow researchers to distinguish perceived and demonstrated AI literacy.

CONCLUSION

Artificial intelligence is rapidly becoming part of the environment in which young people learn, work, and make decisions. The educational question is no longer whether learners will encounter AI but whether they will be prepared to understand and navigate it. For South Africa, this question intersects directly with educational inequality.

If AI literacy develops primarily among learners already benefiting from strong digital infrastructure, advanced curriculum opportunities and well-resourced schools, technological change may deepen existing inequality. The digital divide may evolve into an AI capability divide in which some young people enter higher education and employment able to understand, evaluate and work with AI while others encounter the same systems without equivalent knowledge or agency.

The 237 baseline questionnaires show that learners in these under-resourced schools already recognised AI's relevance to education and work before the workshop. A separate evaluation from 220 learners records

favourable immediate reactions, including reported motivation and reflections on study, careers, and agency. Neither dataset demonstrates an increase in AI literacy or sustained behaviour change.

The study therefore supports a bounded feasibility account: a low-infrastructure workshop was delivered and attracted positive feedback in this context. Its effectiveness remains an open empirical question.

This leads to the article's central proposition: AI literacy should not be postponed until disadvantaged schools become technologically equivalent to their most privileged counterparts. Foundational AI literacy can itself become part of the process of addressing educational inequality.

Grade 11 represents a crucial point of intervention because learners are approaching decisive educational and occupational transitions. Life Orientation provides a potentially practical curricular location because it already addresses careers, personal development, citizenship, and preparation for life and work, and some learners' comments pointed to it. The findings suggest that South Africa could begin piloting foundational AI literacy now, while continuing to build the broader digital infrastructure and teacher capacity that more advanced AI education will require. In this sense, AI literacy is not simply another digital skill. It is becoming part of what it means to be educationally, occupationally, and socially prepared for the future.

Declarations

Funding. The authors received no specific grant for this research from any funding agency in the public, commercial, or not-for-profit sectors.

Competing interests. The authors declare that they have no competing interests.

Ethics approval and consent to participate. The Swiss Institute of Management and Innovation granted ethical approval, and the Gauteng Department of Education granted research approval (approval no. 2024/348; reference 8/4/4/1/2; 03 September 2024). We obtained written consent from school principals, and written parental or guardian consent and learner assent from all participants. Participation was voluntary, and data were anonymised.

Consent for publication. Not applicable. No, individually identifiable data, images, or direct quotations attributable to identifiable learners are included in this article. All learner quotations are anonymous and were collected under conditions of guaranteed anonymity.

Availability of data and materials. The participant-level data is not publicly available because participants consented to anonymous use within the study only. Aggregated data supporting the findings of this study are available from the corresponding author on reasonable request, subject to the conditions of the ethics approval.

Authors' contributions. D. R. Govender designed and conducted the research and prepared the underlying doctoral thesis. W. Goosen supervised the doctoral research and contributed to the development and substantive revision of this article. Both authors read and approved the final manuscript.

Use of generative AI. ChatGPT (OpenAI) and Claude (Anthropic) were used to assist with manuscript restructuring, language editing, formatting to journal requirements, reference checking, and arithmetic consistency checks of reported aggregate figures. Neither tool had access to participant-level data or reanalysed learner responses. The authors reviewed all AI-assisted output and took full responsibility for this article's content.

Acknowledgements. The authors thank the Gauteng Department of Education for allowing this research to be conducted within the public school system; the school principals for their willingness to participate and for providing access to their schools and learners; and the learners, whose engaged and curious participation made this study possible. Patrick Hutchison handled workshop coordination with dedication, and Muhammad Jamal provided critical guidance on the statistical and assessment frameworks.

REFERENCES

1. Ayanwale, M. A., Ntshangase, S. D., Adelana, O. P., Afolabi, K. W., Adam, U. A., & Olatunbosun, S. O. (2024). Navigating the future: Exploring in-service teachers' preparedness for artificial intelligence integration into South African schools. *Computers and Education: Artificial Intelligence*, 7, Article 100330. <https://doi.org/10.1016/j.caeai.2024.100330>
2. Bandura, A. (1997). *Self-efficacy: The exercise of control*. W. H. Freeman.
3. Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101. <https://doi.org/10.1191/1478088706qp063oa>
4. Casal-Otero, L., Catala, A., Fernández-Morante, C., Taboada, M., Cebreiro, B., & Barro, S. (2023). AI literacy in K–12: A systematic literature review. *International Journal of STEM Education*, 10, Article 29. <https://doi.org/10.1186/s40594-023-00418-7>
5. Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). Sage.
6. Creswell, J. W., & Plano Clark, V. L. (2018). *Designing and conducting mixed methods research* (3rd ed.). Sage.
7. Crompton, H., & Burke, D. (2023). Artificial intelligence in higher education: The state of the field. *International Journal of Educational Technology in Higher Education*, 20, Article 22. <https://doi.org/10.1186/s41239-023-00392-8>
8. Cross, S., & Feldman, J. (2025). Artificial intelligence in education: Considerations for South African schooling. *Journal of Education*, 98, 27–41. <https://doi.org/10.17159/2520-9868/i98a02>
9. Department of Basic Education. (2024). Curriculum and assessment policy statement: Coding and robotics, Intermediate Phase Grades 4–6. <https://www.education.gov.za/Portals/0/CD/National%20Curriculum%20Statements%20and%20Vocational/Coding%20and%20Robotics%20IP%20Grade%204%20-%206.pdf>
10. Department of Basic Education. (2025). Strategic plan 2025–2030. https://www.education.gov.za/Portals/0/Documents/Reports/2025/2025-2030%20DBE%20Strategic%20Plan_Compress.pdf
11. Govender, D. R. (2026). AI literacy workshops as a curriculum intervention: Exploring Grade 11 public school pupils' preparedness for the future of education and work in South Africa [Unpublished doctoral thesis]. Swiss Institute of Management and Innovation.
12. Long, D., & Magerko, B. (2020). What is AI literacy? Competencies and design considerations. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems* (pp. 1–16). Association for Computing Machinery. <https://doi.org/10.1145/3313831.3376727>
13. Miao, F., & Holmes, W. (2023). Guidance for generative AI in education and research. UNESCO. <https://unesdoc.unesco.org/ark:/48223/pf0000386693>
14. Ng, D. T. K., Leung, J. K. L., Chu, S. K. W., & Qiao, M. S. (2021). Conceptualizing AI literacy: An exploratory review. *Computers and Education: Artificial Intelligence*, 2, Article 100041. <https://doi.org/10.1016/j.caeai.2021.100041>
15. Ng, D. T. K., Wu, W., Leung, J. K. L., Chiu, T. K. F., & Chu, S. K. W. (2024). Design and validation of the AI literacy questionnaire: The affective, behavioural, cognitive and ethical approach. *British Journal of Educational Technology*, 55(3), 1082–1104. <https://doi.org/10.1111/bjet.13411>
16. Saal, P. E., Chetty, K., Ntshayintshayi, N., Moosa, T., & Masuku, N. (2025). A scoping review of the integration of artificial intelligence in primary and secondary schools from 2020 to 2024: Policy implications for South Africa. *Journal of Education*, 98, 62–85. <https://doi.org/10.17159/2520-9868/i98a04>
17. Shadish, W. R., Cook, T. D., & Campbell, D. T. (2002). *Experimental and quasi-experimental designs for generalized causal inference*. Houghton Mifflin.
18. Statistics South Africa. (2026). Quarterly Labour Force Survey, Quarter 1: 2026 (Statistical release P0211). <https://www.statssa.gov.za/publications/P0211/P02111stQuarter2026.pdf>
19. Tshidi, M., & Dewa, A. (2024). The promise and peril of Coding & Robotics education in South Africa: A scoping review of teacher preparation and generative artificial intelligence's potential for delivering equity. *Journal of Education*, 96, 130–148. <https://doi.org/10.17159/2520-9868/i96a08>

20. UNESCO. (2024). AI competency framework for students.
<https://unesdoc.unesco.org/ark:/48223/pf0000391105>
21. Wang, N., & Lester, J. (2023). K-12 education in the age of AI: A call to action for K-12 AI literacy. *International Journal of Artificial Intelligence in Education*, 33, 228–232.
<https://doi.org/10.1007/s40593-023-00358-x>
22. World Economic Forum. (2025). The future of jobs report 2025.
<https://www.weforum.org/publications/the-future-of-jobs-report-2025/>