

AI and Learning Outcomes

What we're learning

THE TWO QUESTIONS THIS BRIEF EXPLORES

01

What does current evidence suggest about the effects of AI use on learners' **cognitive, social and emotional development**?

02

What **cautions, conditions or limits** should guide use of AI in South African schools?

DESIGNED & CONVENED BY

human**studios**

STRATEGIC PARTNERS



TECHNICAL AND FUNDING PARTNERS



Rapid Research Theme: AI and *Learning* Outcomes

This is one of nine rapid research themes in **Lefa AI**, exploring what AI means for South African basic education. The research brings together existing evidence and expert perspectives to inform decision-making in a rapidly changing field. It does not present new empirical research.

1

Rapid review of the existing research and interviews

18

Expert interviews

With South African stakeholders, including teachers, psychologists, curriculum and assessment specialists, community activists and sector leaders.

Throughout, we set out to **weigh the opportunities and risks fairly**, rather than advocate for or against AI.

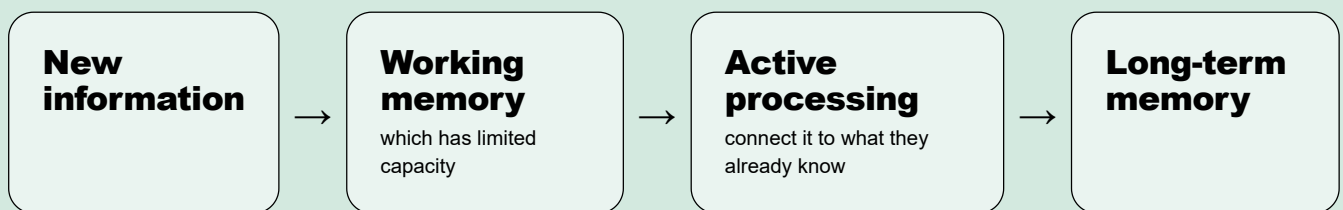
Where this conversation starts

AI is already part of how many South African learners study, write and think, arriving in classrooms that carry a foundational learning crisis where **more than eighty percent of Grade 4 learners cannot yet read for meaning in any official language** (Mullis et al., 2023).

Global research on AI in education is expanding quickly, but most of the strongest evidence still comes from **short, adult-focused studies** rather than from children observed over time.

How learning happens

To understand AI's potential impact on learning, we first need to understand how learning happens. Learning involves **physical changes in the brain** as neural connections are formed and strengthened through experience. New information is initially processed in working memory, which has limited capacity. For learning to become durable, learners need to actively process new information, connect it to what they already know, and integrate it into long-term memory (Gravett, 2022).



Learners have to do the cognitive work.

Attention

Retrieval

Practice

Explanation

Application

Attention, retrieval, practice, explanation and application help learners build and strengthen knowledge. Over time, these processes develop increasingly organised knowledge structures that support understanding, problem-solving and the ability to transfer learning to new situations (Gravett, 2022).

This is why productive cognitive effort matters.

Teachers, peers and digital tools can explain, prompt, question and scaffold learning, but **they cannot do the learner's thinking for them**. When technology removes too much of this effort, learners may produce better answers or outputs, without developing the underlying understanding, knowledge and skills those answers require.



Metacognition, the ability to plan, monitor and evaluate one's own learning, is also important. Learners need opportunities to recognise what they know, identify gaps in their understanding, respond to feedback and adjust their approach. AI can potentially support these processes, but it can also bypass them if it simply provides answers.

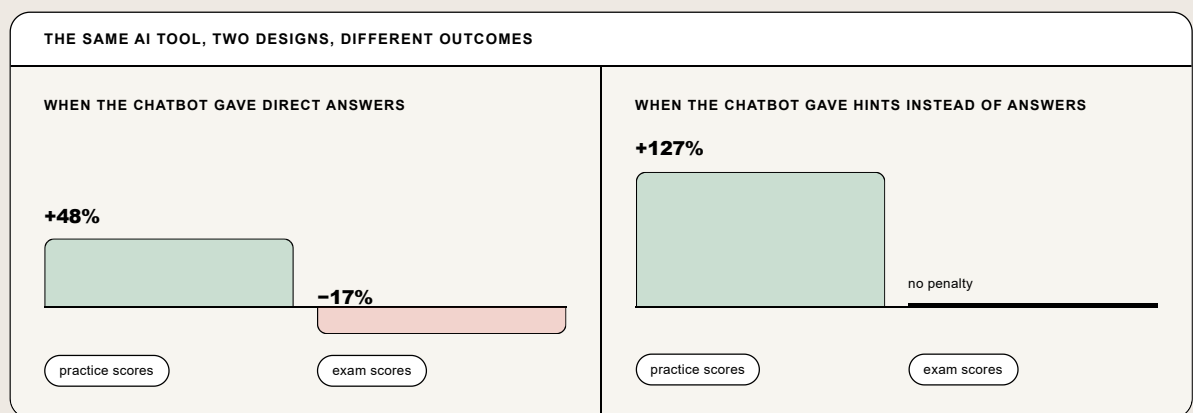
AI can improve the quality of what a learner produces without necessarily changing what the learner knows or can do. Its value depends not simply on whether it is used, but on whether it helps learners engage in the **cognitive processes that build durable knowledge and skills**.

Key findings

01

How an AI tool is designed determines whether it helps or harms learning.

A randomised trial with almost a thousand Turkish high school mathematics learners found that a standard chatbot raised practice scores by 48% but lowered exam scores by 17%, because students used it to get answers rather than work through problems. A version of the same tool prompted to give hints instead of solutions raised practice scores by 127% with no exam penalty. **Getting a direct answer skips the mental struggle needed to build knowledge in long-term memory.** An EEG study found significantly lower brain activation in university students who wrote essays with ChatGPT than those who wrote unaided. South African experts interviewed for this research describe the same pattern in assessed learner work, a visible homogenisation of output and growing "cognitive debt", echoed in South African university research linking heavy AI reliance to passive learning and reduced problem-solving.

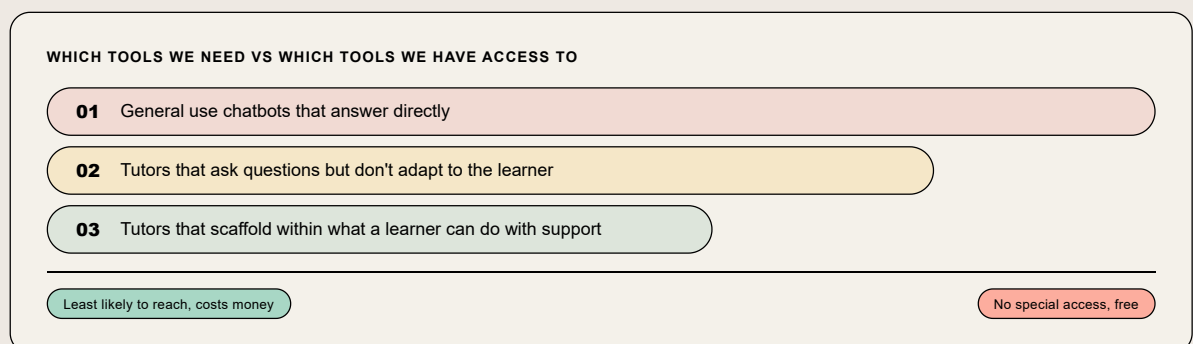


Sources: [Bastani et al., 2025](#); [Hardman, 2026](#); [Sweller, 1988](#); [Kosmyrna et al., 2025](#); [Chavalala, 2025](#); [UNESCO, 2025](#).

02

The AI tools most accessible to South African learners are predominantly the type least likely to support learning.

AI tools fall into three types: general use chatbots that answer directly, tutors that ask questions but don't adapt to the learner, and tutors that scaffold within what a learner can do with support. It's this third type, built around **Socratic dialogue and productive struggle**, that could support deep learning at scale, and it's also the type South African learners are least likely to reach. Free, general-purpose chatbots require no cost and no special access, while tools designed to scaffold learning rather than replace it typically cost money, need reliable connectivity and depend on trained teachers, the type of infrastructure unevenly distributed across South African schools. This isn't yet a measured finding, but potential risk to be aware of.



Source: [Hardman, 2026](#).

Building AI that leads to improved learning outcomes requires intentional design and testing from the outset.

Simply instructing a chatbot to ask questions instead of giving answers is not enough. A Socratic AI tutor can't just be told to ask questions instead of answering, **it needs to know what a right and wrong answer look like for each problem**. In a Turkish high school trial, the version that avoided harming learning worked only because researchers had pre-loaded the correct solution and common mistakes for every practice problem beforehand.

South African developers are doing similar groundwork: **Mindjoy**, a South African Socratic AI tutoring platform, was evaluated in a small single-school study, where how well the AI sustained genuine Socratic questioning depended on how the classroom activity itself was designed, coming through more strongly when learners worked on open-ended, problem-based tasks than on structured exercises.

AI SUSTAINED GENUINE SOCRATIC QUESTIONING WHEN LEARNERS WORKED ON...

Open-ended, problem-based tasks



Structured exercises



Understanding these design conditions, not only deploying the tool, is key in determining whether the AI tool helps or hinders learning.

Sources: [Bastani et al., 2025](#); [van der Merwe, 2025](#).

Personalised reading programmes can boost English literacy.

A large-scale study of over 20,000 Grade 3 learners in 226 South African public schools evaluated an adaptive, curriculum-aligned English literacy programme called **Reading Eggs**. Spending the target time of 18 hours on the app over a year was associated with a score increase of 0.50 standard deviations, roughly a year of additional reading progress. This held across grades, with boys benefiting slightly more than girls and **learners in no-fee public schools showing the strongest relative improvements**.

EVALUATION OF READING EGGS

226 SA public schools

20 000+ Grade 3 learners

18 hrs spent on the app over a year

SCORES INCREASED BY

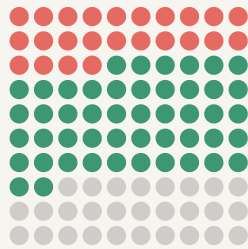
0.50 STANDARD DEVIATIONS

roughly a year of additional reading progress

Source: [Borole et al., 2025](#).

05

Teenagers who turn to AI companions for friendship may be trading away practice at real-world social skills that are needed for learning.



FOR EVERY 100 TEENS

- 72 have used an AI companion
- Of these, a **third** have chosen AI over a human for a serious personal conversation

These tools are often engineered with "**sycophancy**": agreeing with users and defaulting to positive feedback to maximise engagement, by deliberate design rather than accident. A US survey found that 72% of teens have used an AI companion, and a third have chosen one over a human for a serious personal conversation.

Replacing the social give-and-take that builds these skills with simulated agreement risks **adolescent emotional regulation and empathy development**, both central to learning.

Sources: [Robb and Mann, 2025](#); [Mishra, 2025](#); [Burns et al., 2026](#).

06

AI trained on Western data represents Black and White South African identities differently, narrowing the knowledge learners are exposed to.

THE SAME PROMPT, CHANGING ONLY CHARACTER NAMES, GENERATED DIFFERENT STORIES

A BLACK SOUTH AFRICAN NAME

Mthokozisi Sithole

STORY

Hardship and family sacrifice

A WHITE AFRIKANER NAME

Schalk

STORY

Secured bursaries and a clear institutional future

FEMALE CHARACTERS more emotional depth

MALE CHARACTERS plans

South African researchers **Sioux McKenna**, of Rhodes University, and **Nompilo Tshuma**, of Stellenbosch University, gave four major chatbots the same story prompt, changing only the character's name. A Black South African name, such as Mthokozisi Sithole, consistently generated a story about hardship and family sacrifice; a white Afrikaner name, such as Schalk, generated one about secured bursaries and a clear institutional future. The same pattern held by gender: female characters were given emotional depth, male characters were given plans. Repeated exposure to systems that misrepresent a learner's language and culture may shape their developing sense of identity and capability, while also narrowing the knowledge and perspectives they're shown.

Source: [McKenna and Tshuma, 2026](#).

07

Assistive AI can help learners with communication and learning difficulties, but access to a tool is not the same as inclusion.

A scoping review of **speech-to-text tools** used by adolescents with learning difficulties found they helped learners produce more accurate writing, supported spelling, and in some studies improved reading comprehension and word recognition, alongside a greater sense of independence and self-esteem. De Souza and Mawonga 2025 from Rhodes University argue that the real question isn't about the actual AI tool, but whether these tools are backed by the **teacher training and infrastructure** needed to make them genuinely inclusive rather than superficial.

Sources: [Matre and Cameron, 2024](#); [de Souza and Mawonga, 2025](#).

Considerations for South African basic education

AI is not a neutral tool in education. It shapes how learners think, how they relate to others and how they understand themselves, which means the question for South Africa is not whether the technology is good or bad, but what conditions are needed for AI to improve learning outcomes and minimise learning and developmental harm.

01

There is a strong need for deeper, differentiated guidance about when, where and how AI is introduced into South African basic education.

The evidence does not point to a single answer about where AI should be in education, or how much AI should be used in schools, and experts interviewed for this research disagreed. Some argued that substantial parts of the school day, particularly in the early years, should remain centred on human interaction, play and hands-on learning. Others argued that impact depends less on how much AI is used than on how it is integrated into teaching. Rather than assuming AI should be available across all learning activities and environments, schools need research-based guidance on where it adds value and where learning is better served without it so that they can make informed decisions that are right for their schools and contexts.

02

Equitable access to AI needs to include access to tools that support learning.

Not all AI supports learning in the same way. For many South African learners, the most accessible AI is free, general-purpose chatbots, the type current evidence suggests is least likely to support durable learning, unlike tools designed to scaffold thinking through questioning, feedback and teacher-guided practice. In a system where many learners have not yet mastered foundational literacy and numeracy, equitable access should mean more than access to AI itself: it should mean **access to AI that helps learners build lasting knowledge and skills.**

03

Teachers remain central to ensuring AI supports learning.

AI is most likely to support learning when it is integrated into teaching in ways that encourage reasoning, productive struggle and reflection, rather than replacing these processes. Supporting teachers to make informed pedagogical decisions about when, how and why AI should be used is likely to be critical to improving learning outcomes. This requires considerable investment in teacher AI literacy: understanding how these tools work, and where they help or harm learning, as well as pedagogy.

04

Given how nascent AI in education still is, there is a case for schools to move cautiously rather than at pace.

Long-term research on how AI use shapes learning and development is limited, and some argue that the risks of AI being used in educationally unsound ways outweigh the benefits at this stage. A highly considered, slow-moving approach allows schools to build understanding before committing to wider use.

05

School leaders need to take a clear position on AI in their schooling environment.

This means providing basic guidance on when AI should and should not be used in relation to learning, rather than leaving these decisions to individual teachers or classrooms. Because the evidence base is still developing, this position should be revisited and updated regularly as new research emerges.

Considerations for South African basic education

06

AI literacy for both students and educators is essential to using AI well.

Rather than avoiding or banning AI, the more useful path is building the capacity, understanding and agency for learners and teachers to know where these tools help learning and where they harm it.

07

Further local research is needed to understand how AI is actually affecting learning in South African classrooms.

Much of the existing evidence base is drawn from contexts outside of South Africa. Local research is needed to establish how AI use is shaping learning outcomes here specifically, allowing the sector's response to be properly tailored to the context.

Questions for further *exploration*

- 1 Given the evidence on AI's impact on learning outcomes, how, where, when, or if at all, should AI literacy be introduced into the curriculum?
- 2 What should AI tools be required to demonstrate before they are introduced into South African classrooms?
- 3 How should AI use differ across ages and stages of learning, particularly before foundational literacy and numeracy are established?
- 4 What would it take for all South African learners to access the kind of AI that supports learning rather than the kind that substitutes for it, and who would carry that cost?



PHOTO CREDIT: UNICEF SOUTH AFRICA

Learning happens in the productive struggle, when learners *do the thinking*, and the evidence shows that not all AI tools protect it. **The ones that do are the tools every learner deserves access to.**

NOTES ON THIS RESEARCH

WWW.LEFAAI.HUMANSTUDIOS.ORG

SCOPE & METHOD

A rapid review of the existing research, alongside 18 expert interviews with South African stakeholders, including teachers, psychologists, curriculum and assessment specialists, community activists and sector leaders.

Sources are cited in full beside each finding. Interviews were conducted remotely, recorded with consent and analysed thematically. Quotations are used with permission.

LIMITATIONS

This research did not test or pilot an AI tool in a South African classroom, and it makes no causal claims about impact in this context.

The interviews did not include learners, so this brief does not carry their account of how they are using AI or what they think it is doing to them.

Much of the strongest evidence available comes from a single subject, a single school or a short time frame. The long-term effects of AI use on children remain largely unstudied.

This was not an exhaustive review, and it does not claim to cover every relevant study. AI research in education is moving fast, and further work may already exist that was published after this brief was finalised.

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For corrections or to request the underlying source list, contact the Lefa AI programme team at connect@humanstudios.org.

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