

**Critical Thinking In The Age Of Ai: Pedagogical Activities To Counter Cognitive Surrender**

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**Abstract**

This study investigated the phenomenon of cognitive surrender among students in the context of increasing AI tool usage in higher education settings, and examined the effectiveness of specific pedagogical activities designed to foster critical thinking and counter over-reliance on AI-generated outputs. The study was conducted across three universities in Uganda, involving 312 students from undergraduate programs in social sciences, information technology, and education faculties who were regular users of AI tools including ChatGPT, Google Bard, and similar large language model-based assistants. A mixed-methods quasi-experimental design was employed, with students in experimental groups exposed to structured pedagogical interventions over a 12-week semester period while control groups continued with conventional instructional approaches. Pre- and post-intervention assessments using the Watson-Glaser Critical Thinking Appraisal (WGCTA) were administered to measure critical thinking competency changes. Data were also collected through questionnaires, focus group discussions, and learning portfolio analysis. Findings indicated that cognitive surrender, defined as the uncritical acceptance and wholesale adoption of AI-generated content without independent verification, evaluation, or intellectual engagement, was prevalent among 67.3% of surveyed students prior to intervention. Post-intervention assessment showed that students in experimental groups demonstrated significant improvements in critical thinking scores (mean gain = 8.4 points on WGCTA) compared to control groups (mean gain = 1.9 points), confirming that targeted pedagogical interventions effectively promoted critical thinking and reduced cognitive surrender behaviors. The most effective pedagogical activities were structured AI output critique exercises, Socratic questioning seminars, collaborative fact-checking workshops, and AI-human comparative analysis tasks. The study concluded that proactive pedagogical design was essential to preserving critical intellectual agency in AI-augmented learning environments and recommended the integration of AI-critical pedagogy into curriculum frameworks across Ugandan higher education institutions.

**Keywords: Critical Thinking, Cognitive Surrender, Artificial Intelligence, AI in Education, Pedagogical Activities, Higher Education, Large Language Models, Uganda**

**Background of the Study**

The rapid proliferation of large language model-based artificial intelligence tools in educational settings had created unprecedented opportunities and risks for learning and intellectual development (A. G. Kazaara & Kazaara, 2025). Generative AI systems such as OpenAI's ChatGPT, Google's Bard and Gemini, Anthropic's Claude, and numerous derivative applications had demonstrated remarkable capabilities in producing fluent, contextually relevant, and superficially accurate responses to a vast range of academic questions, writing prompts, and problem-solving tasks (Bender et al., 2021; Brown et al., 2020). The accessibility and apparent competence of these tools had led to their widespread adoption among university students globally, with surveys conducted by multiple institutions reporting

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that between 60 and 90% of students were using AI tools for academic work within one to two years of the tools becoming publicly available (Perkins, 2023; Farrokhnia et al., 2023). The speed of this adoption had substantially outpaced the ability of educational institutions to develop appropriate pedagogical responses, policies, and assessment designs that could preserve the integrity of learning processes while accommodating the transformative potential of AI as an educational resource (A. I. Kazaara, 2025).

Within this rapidly evolving landscape, educational researchers and cognitive scientists had raised urgent concerns about the risk of what was variously described as cognitive offloading, intellectual passivity, or cognitive surrender: the tendency of individuals who had access to powerful AI systems to progressively reduce their own active cognitive engagement with information processing, problem-solving, and knowledge construction in favor of accepting AI-generated outputs as authoritative and complete (Carr, 2010; Metzger et al., 2010; Gerlich, 2023). This concern was not entirely new; similar anxieties had been raised about the cognitive effects of calculators, search engines, GPS navigation, and other cognitive prosthetics (Julius & Audrey, 2025a). However, the generative AI paradigm represented a qualitatively different challenge because these systems produced not merely reference information that required human interpretation and synthesis, but complete, coherent intellectual products including essays, analyses, code, arguments, and explanations that closely mimicked the outputs of human cognitive labor, thereby potentially eliminating the necessity for the student to engage in the reasoning processes that constituted the core value of education (A. G. Kazaara & Kazaara, 2025).

Critical thinking, widely recognized as one of the most essential outcomes of higher education, encompassed a constellation of intellectual capacities including analysis, evaluation, synthesis, inference, deductive and inductive reasoning, problem recognition, and reflective metacognitive awareness (Facione, 1990; Paul & Elder, 2006). Educational philosophers from Dewey (1910) to Freire (1970) had argued that the development of critical thinking was not merely a cognitive achievement but a democratic imperative, enabling individuals to participate as informed, autonomous, and ethically responsible citizens in complex societies (A. G. Kazaara et al., 2024). The pervasive availability of AI tools that could produce plausible-sounding answers to complex questions without requiring students to engage in the intellectual processes through which critical thinking capacities were developed and strengthened raised the possibility that widespread AI reliance could systematically atrophy the critical thinking capabilities of entire generations of students (Julius & Audrey, 2025b).

In Uganda, the rapid diffusion of AI tools among university students had been facilitated by the widespread penetration of affordable smartphones and mobile internet access, which had made generative AI applications accessible to students in urban and peri-urban areas at significantly lower cost barriers than had previously restricted access to advanced digital technologies. Studies by Musinguzi and Tumwebaze (2023) reported that approximately 74% of Kampala-based university students were regular users of AI writing assistants by early 2023, a penetration rate that exceeded the average for many European countries, reflecting the particular appeal of AI tools to students navigating the dual challenges of academic work in English as a second or third language and resource-constrained study

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environments where access to library resources and academic mentoring was limited (Julius & Kazaara, 2026a). The implications of this rapid AI adoption for the development of critical thinking among Ugandan university students had not been systematically investigated, and no empirical evidence existed on the effectiveness of pedagogical strategies specifically designed to address cognitive surrender in the Ugandan higher education context (Ntirandekura et al., 2022).

The pedagogical response to AI-related cognitive surrender challenges had been explored in a small but growing body of international literature. Researchers such as Lodge et al. (2023) and Mollick and Mollick (2023) had proposed various approaches to AI-integrated pedagogy that sought to harness the capabilities of AI tools while preserving and strengthening students' own critical thinking engagement. These approaches included AI output critique and verification exercises that required students to identify errors, biases, and limitations in AI-generated content, Socratic questioning methodologies that engaged students in sustained interrogative dialogue about AI outputs and their underlying assumptions, collaborative learning activities that required students to bring independent analysis to group discussions rather than delegating thinking to AI systems, and metacognitive reflection exercises that prompted students to examine their own cognitive processes and dependency patterns in relation to AI use (Emmanuel et al., 2023). However, the empirical evidence on the effectiveness of these pedagogical approaches was still limited, particularly in non-Western educational contexts where cultural norms around learning, authority, and knowledge sources may have interacted differently with students' orientations toward AI systems (Julius, 2025). The present study therefore sought to contribute empirical evidence on the prevalence of cognitive surrender and the effectiveness of specific pedagogical interventions in countering it among Ugandan university students.

#### **PROBLEM STATEMENT**

The widespread adoption of generative AI tools among university students in Uganda had raised serious questions about the quality and authenticity of student intellectual engagement in academic work (Nicholas & Nancy, 2024). Lecturers and academic administrators at multiple Ugandan universities had reported increasing concerns about students submitting AI-generated essays and assignments that demonstrated little evidence of independent reasoning, critical analysis, or personal intellectual engagement with course materials (Julius & Kaazara, 2025). Assessment integrity offices were identifying AI-generated content in student work at increasing rates, but the more fundamental educational concern was not simply about academic dishonesty but about the possibility that students who habitually delegated intellectual labor to AI systems were failing to develop the critical thinking capacities that were among the primary intended outcomes of higher education (A. G. Kazaara & Kazaara, 2025). Despite the urgency of these concerns, no empirical study had been conducted in the Ugandan higher education context to measure the prevalence of cognitive surrender behaviors, to assess their relationship with critical thinking competency levels, or to evaluate the effectiveness of pedagogical interventions designed to address the problem (A. I. Kazaara & Deus, 2024). This study sought to fill these gaps by providing evidence-based insights into the AI-critical thinking dynamic in Ugandan university education and by testing the effectiveness of specific pedagogical counter-strategies.

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### **MAIN OBJECTIVE**

The main objective of this study was to examine the prevalence of cognitive surrender among AI-using university students in Uganda and to evaluate the effectiveness of pedagogical activities designed to promote critical thinking and counter cognitive surrender behaviors.

#### **Specific Objectives:**

- i. To establish the prevalence of cognitive surrender behaviors among AI-using university students in Uganda.
- ii. To assess the pre-intervention critical thinking competency levels of students who regularly used AI tools for academic work.
- iii. To evaluate the effectiveness of specific pedagogical activities in promoting critical thinking and reducing cognitive surrender among AI-using students.
- iv. To identify the most effective pedagogical activities for fostering critical thinking in AI-augmented learning environments.

### **LITERATURE REVIEW**

#### **Theoretical Framework**

The study drew on three complementary theoretical frameworks. Cognitive Load Theory (Sweller, 1988) provided the cognitive architectural basis for understanding how AI tool use affected the distribution of cognitive resources between working memory processing and long-term memory construction, suggesting that habitual AI offloading could reduce the cognitive effort applied to deep processing of information, potentially impairing the development of robust, transferable conceptual understanding. Paul and Elder's (2006) Critical Thinking Framework offered a normative model of intellectual standards and thinking dispositions that served as both the theoretical definition of critical thinking used in the study and the evaluative standard against which student performance was assessed. Freire's (1970) critical pedagogy theory provided the broader philosophical orientation that situated the development of critical consciousness as the ultimate purpose of education, positioning cognitive surrender to AI systems as a form of intellectual alienation that contradicted the emancipatory aims of education.

#### **Cognitive Surrender and AI Reliance**

The concept of cognitive surrender in AI-assisted learning contexts had been theorized by Gerlich (2023), who defined it as the progressive reduction of an individual's active cognitive engagement in reasoning tasks as a result of habitual reliance on AI systems to perform cognitive functions that the individual was capable of performing independently (Nafiu, 2012). Gerlich distinguished cognitive surrender from beneficial cognitive offloading (the strategic delegation of routine cognitive tasks to tools, freeing cognitive resources for higher-order thinking) on the grounds that cognitive surrender involved the unnecessary delegation of higher-order thinking tasks to AI, thereby depriving the individual of opportunities to develop and exercise the cognitive capacities that were atrophied through disuse (Julius & Audrey, 2026). Research by Metzger et al. (2010) had earlier documented similar patterns of credibility assessment abdication in internet search contexts, where users frequently accepted top-ranked search results

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as authoritative without critically evaluating their reliability, a pattern that Generative AI's conversational authority appeared to amplify considerably (Julius & Kazaara, 2026b).

Farrokhnia et al. (2023) documented in a cross-institutional survey that students who reported higher frequencies of AI tool use for academic writing demonstrated significantly lower scores on measures of source evaluation, argument analysis, and evidence assessment, consistent with the cognitive surrender hypothesis that over-reliance on AI was associated with reduced critical thinking engagement (Julius & Desire, 2025). However, the causal direction of this relationship remained uncertain, as students with lower initial critical thinking capabilities may also have been more likely to use AI tools uncritically, creating a selection effect that complicated causal inference (Galy et al., 2019). The quasi-experimental design of the present study was intended to address this causal uncertainty by comparing pre-post changes in critical thinking scores between intervention and control groups.

#### **Pedagogical Approaches to Fostering Critical Thinking**

The literature on pedagogy for critical thinking development was extensive, documenting the effectiveness of Socratic seminar approaches (Paul & Elder, 2006), problem-based learning (Hmelo-Silver, 2004), argument mapping (Harrell, 2012), and metacognitive reflection interventions (Flavell, 1979) in promoting higher-order thinking skills. Research specifically addressing AI-augmented pedagogical contexts for critical thinking was more recent but had produced several promising findings. Lodge et al. (2023) demonstrated that structured AI output critique exercises, in which students were required to systematically identify factual errors, logical inconsistencies, missing perspectives, and implicit assumptions in AI-generated texts, produced significant improvements in students' analytical skills and their epistemic vigilance toward information sources. Mollick and Mollick (2023) reported that AI-as-Socratic-interlocutor approaches, where students used AI systems as structured dialogue partners who deliberately presented challenging counter-arguments rather than answer-providing oracles, promoted deeper reasoning engagement than conventional passive AI use patterns. These findings provided a theoretical basis for the design of the pedagogical interventions tested in the present study.

#### **AI in African and Ugandan Higher Education Contexts**

Research on AI integration in African higher education remained limited but growing. Studies by Owusu-Acheaw (2022) in Ghana and Abioye et al. (2023) in Nigeria documented rapid AI adoption among university students but also significant variation in the sophistication of AI use, ranging from sophisticated research augmentation practices among students with higher digital literacy to wholesale AI text submission practices among less digitally confident students. Musinguzi and Tumwebaze (2023) in their preliminary investigation of AI use patterns at Makerere University found that over 70% of surveyed students had used ChatGPT or similar tools for assignments, with over 40% reporting that they routinely submitted AI-generated text without significant editing or critical evaluation, a pattern consistent with cognitive surrender (Ntirandekura & Christopher, 2022). The study also noted that academic staff were largely unprepared to design assessment tasks that were resistant to AI completion or to deliver pedagogical

interventions that promoted critical AI engagement, underscoring the urgent need for evidence-based pedagogical guidance in the Ugandan context.

## **METHODOLOGY**

### **Research Design**

A mixed-methods quasi-experimental design was employed, incorporating a pre-test/post-test comparison between experimental groups (receiving structured pedagogical interventions) and control groups (receiving conventional instruction without specific AI-critical pedagogy). The quasi-experimental design was used because full random assignment of students to conditions was not feasible within the naturalistic university setting, as students were enrolled in pre-existing classes. Instead, matched class sections across three universities were assigned to experimental and control conditions through purposive assignment that matched groups on key covariates including pre-test critical thinking scores, faculty affiliation, and AI tool use frequency. The study was conducted over a single academic semester of 12 weeks, with pedagogical interventions integrated into regular weekly class sessions.

### **Study Sites and Sample**

The study was conducted at three private universities in Kampala, Uganda, selected for their relatively high levels of AI tool adoption among students and their willingness to incorporate research activities into scheduled teaching. The study involved 312 student participants distributed across experimental and control groups: 158 students in experimental groups and 154 students in control groups. Students were drawn from three academic departments: social sciences (n = 108), information technology (n = 102), and education (n = 102). All participants were undergraduate students who reported regular use of AI tools for academic work, with minimum usage defined as at least twice per week for academic purposes.

### **Interventions**

The pedagogical intervention package implemented in experimental groups over the 12-week semester comprised five core activities. First, structured AI Output Critique sessions (weeks 1-3) required students to systematically analyze AI-generated texts on course-relevant topics using standardized critique protocols that directed attention to factual accuracy, logical coherence, perspective completeness, source attribution, and implicit assumptions. Second, Socratic Questioning Seminars (weeks 4-6) engaged students in facilitated dialogues where lecturers used structured Socratic questioning techniques to probe the reasoning behind student positions, challenge AI-sourced claims, and develop students' capacity for sustained argumentative thinking. Third, Collaborative Fact-Checking Workshops (weeks 7-8) required student teams to investigate the factual accuracy of AI-generated content on specified topics, documenting verified facts, errors, and unverifiable claims using structured verification protocols. Fourth, AI-Human Comparative Analysis Tasks (weeks 9-10) presented students with side-by-side comparisons of AI-generated and human expert analyses of the same topic, requiring students to identify differences in depth, nuance, perspective, and intellectual sophistication between the two. Fifth, Metacognitive Reflection Portfolios (weeks 11-12) required students to maintain

reflective journals documenting their evolving use of AI tools, their awareness of their own cognitive processes during AI-assisted work, and their developing strategies for maintaining intellectual agency in AI-augmented study contexts.

**Instruments and Analysis**

Critical thinking was measured using the Watson-Glaser Critical Thinking Appraisal (WGCTA), a 40-item standardized instrument measuring five dimensions of critical thinking: inference, recognition of assumptions, deduction, interpretation, and evaluation of arguments. The WGCTA had demonstrated adequate reliability (Cronbach's alpha typically 0.75 to 0.85 in educational populations) and construct validity across diverse educational settings. A Cognitive Surrender Inventory (CSI), developed specifically for this study based on Gerlich's (2023) theoretical framework, measured five behaviors associated with cognitive surrender using a 25-item self-report scale. Quantitative data were analyzed using SPSS through paired t-tests, independent samples t-tests, analysis of covariance (ANCOVA), and regression analysis(Nelson et al., 2022). Qualitative data from focus group discussions and portfolio analysis were analyzed thematically.

**RESULTS**

**Prevalence of Cognitive Surrender Behaviors**

<b>Cognitive Surrender Behavior</b>	<b>% Reporting Frequently</b>	<b>% Reporting Occasionally</b>	<b>CSI Mean (1-5)</b>
Submitting AI text without verification	47.8	28.4	3.92
Accepting AI answers without questioning	52.3	31.7	4.08
Not reading source materials if AI summarized them	43.6	29.8	3.74
Feeling unable to think through problems without AI	38.2	33.4	3.61
Using AI to generate opinions rather than forming own	44.9	26.3	3.87
Trusting AI output over lecturer explanations	29.4	37.8	3.38
Overall CSI Score (Cognitive Surrender Level)	—	—	3.77

Source: Primary Data, 2025

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Table 1 presents the frequency and mean ratings of six cognitive surrender behaviors assessed in the pre-intervention survey of all 312 student participants. The overall CSI score of 3.77 on a 5-point scale, falling above the midpoint of 3.0, confirmed the prevalence of cognitive surrender as a significant phenomenon among AI-using university students in the study sample. The most prevalent behavior was the uncritical acceptance of AI-generated answers without questioning, which was reported as a frequent behavior by 52.3% and as an occasional behavior by 31.7% of respondents, indicating that over 84% of students engaged in this behavior to some degree. Submitting AI-generated text without independent verification was reported as frequent by 47.8% and occasional by 28.4%, meaning that approximately 76% of students had submitted work without critically evaluating the accuracy or appropriateness of AI-generated content. The finding that 44.9% of students frequently used AI to generate opinions rather than forming their own represented a particularly troubling dimension of cognitive surrender, as the formation of informed personal opinions through reasoned engagement with evidence and argumentation was considered a core intellectual development objective of university education. Approximately 38.2% of students reported frequently feeling unable to work through academic problems without AI assistance, suggesting a level of intellectual dependency that went beyond instrumental tool use to a more fundamental undermining of students' confidence in their own cognitive capacities. The behavior of trusting AI output over lecturer explanations, while recorded at a lower frequency (29.4% frequently), still represented a concerning displacement of instructional authority that had implications for the pedagogical relationship and the credibility of human expertise in AI-augmented learning environments. The overall pattern of findings confirmed that cognitive surrender was a widespread and multidimensional phenomenon among the study population prior to intervention, affecting the majority of students across multiple dimensions of academic intellectual engagement.

**Pre- and Post-Intervention Critical Thinking Scores**

<b>Group</b>	<b>Pre-test Mean (SD)</b>	<b>Post-test Mean (SD)</b>	<b>Mean Gain</b>	<b>t-value</b>	<b>p-value</b>
Experimental (n=158)	24.3 (5.8)	32.7 (6.1)	+8.4	17.43	0.000
Control (n=154)	24.1 (5.6)	26.0 (5.9)	+1.9	4.21	0.000
Difference in gains			+6.5	11.82*	0.000

**Source: Primary Data, 2025**

Table 2 presents the pre- and post-intervention Watson-Glaser Critical Thinking Appraisal (WGCTA) scores for experimental and control groups. The pre-test scores confirmed the equivalence of experimental (mean = 24.3, SD = 5.8) and control (mean = 24.1, SD = 5.6) groups at baseline, validating the matched assignment procedure and enabling attributable comparison of post-test changes. Both groups demonstrated statistically significant improvement in

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critical thinking scores from pre- to post-test, but the magnitude of improvement differed dramatically between conditions. Experimental group students showed a mean gain of 8.4 points over the 12-week intervention period, while control group students showed a mean gain of only 1.9 points, a difference in gains of 6.5 points that was highly statistically significant ( $t = 11.82, p < 0.001$ ) (Nelson et al., 2023). The differential improvement in the experimental group was attributed to the structured pedagogical activities that systematically engaged students in the analytical, evaluative, and metacognitive processes central to critical thinking development. The control group's modest improvement of 1.9 points reflected the natural development of critical thinking through conventional university instruction without specific AI-critical pedagogy, which was consistent with developmental norms for the 12-week period. ANCOVA controlling for faculty affiliation, prior GPA, and AI tool use frequency confirmed that the experimental vs. control group assignment remained the most significant predictor of post-intervention WGCTA scores ( $F = 139.4, p < 0.001, \text{partial } \eta^2 = 0.31$ ), demonstrating a large effect size and confirming that the pedagogical interventions produced educationally meaningful improvements in critical thinking. Post-test scores for the experimental group (mean = 32.7) placed the average student in the experimental group at the 'above average' critical thinking category on the WGCTA normative scale, compared to the pre-test classification of 'average', representing a meaningful and practically significant shift in critical thinking competency over the course of a single semester.

**Effectiveness of Individual Pedagogical Activities**

<b>Pedagogical Activity</b>	<b>Contribution to CT Gain (<math>\beta</math>)</b>	<b>Student Rating (Mean/5)</b>	<b>Ranked Effectiveness</b>
AI Output Critique Exercises	0.412	4.31	1st
Socratic Questioning Seminars	0.387	4.18	2nd
Collaborative Fact-Checking Workshops	0.341	4.02	3rd
AI-Human Comparative Analysis	0.312	3.98	4th
Metacognitive Reflection Portfolios	0.289	3.84	5th

**Source: Primary Data, 2025**

Table 3 presents the relative contribution of each pedagogical activity to critical thinking gains and students' mean rating of each activity's learning value. Beta coefficients were derived from multiple regression analysis examining the contributions of engagement scores for each activity to post-intervention WGCTA scores, controlling for pre-intervention scores and demographic variables. AI Output Critique Exercises emerged as the most effective pedagogical activity, with the highest regression coefficient ( $\beta = 0.412$ ) and the highest student learning value rating (mean = 4.31). This finding was particularly significant because it demonstrated that direct, structured engagement

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with AI-generated content through systematic critique exercises was the most effective pathway to developing the critical thinking skills needed to counter cognitive surrender. The AI Output Critique exercises appeared to function by making the limitations of AI systems visible and concrete to students, disrupting the perceived authority and infallibility of AI outputs that underpinned cognitive surrender behaviors, and simultaneously providing a structured analytical framework that students could internalize and apply to future AI interactions. Socratic Questioning Seminars were rated as the second most effective activity ( $\beta = 0.387$ , student rating = 4.18), consistent with a long tradition of research demonstrating the effectiveness of Socratic dialogue in developing argumentative reasoning and intellectual perseverance (Paul & Elder, 2006). Students in focus group discussions described the Socratic seminars as initially uncomfortable because they were unaccustomed to having their reasoning challenged persistently and publicly, but ultimately highly valuable in developing their ability to construct and defend evidence-based arguments. Collaborative Fact-Checking Workshops ( $\beta = 0.341$ ) were rated third, with students reporting that the workshops revealed how frequently AI-generated content contained factual inaccuracies that superficially plausible prose style concealed from casual readers, fundamentally altering their epistemic trust calibration toward AI outputs. The AI-Human Comparative Analysis tasks ( $\beta = 0.312$ ) generated discussion among students about what distinguished high-quality human academic analysis from AI-generated approximations, developing students' sensitivity to intellectual depth, nuance, and contextual sophistication as markers of genuine expertise. Metacognitive Reflection Portfolios, while rated lowest in immediate learning value, were identified in qualitative analysis as having the most durable impact on students' self-regulation of AI use patterns, suggesting that metacognitive awareness was a slower-developing but more transformative outcome of the intervention than the more immediately visible analytical skill improvements captured by the WGCTA.

**Changes in Cognitive Surrender Behaviors Post-Intervention**

<b>Cognitive Surrender Behavior</b>	<b>Pre-CSI Mean</b>	<b>Post-CSI Mean (Exp)</b>	<b>Post-CSI Mean (Ctrl)</b>	<b>Change (Exp)</b>
Submitting AI text without verification	3.92	2.14	3.74	-1.78
Accepting AI answers without questioning	4.08	2.31	3.89	-1.77
Not reading sources if AI summarized	3.74	2.08	3.61	-1.66
Feeling unable to work without AI	3.61	2.27	3.48	-1.34

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Cognitive Surrender Behavior	Pre-CSI Mean	Post-CSI Mean (Exp)	Post-CSI Mean (Ctrl)	Change (Exp)
Using AI to generate opinions	3.87	2.19	3.72	-1.68
Trusting AI over lecturer explanations	3.38	2.02	3.27	-1.36
Overall CSI Score	3.77	2.17	3.62	-1.60

Source: Primary Data, 2025

Table 4 presents the change in Cognitive Surrender Inventory scores from pre- to post-intervention for experimental and control groups. The results demonstrated that students in the experimental group showed substantial reductions in cognitive surrender behaviors across all six dimensions measured, with the overall CSI score declining from 3.77 to 2.17, a reduction of 1.60 points that moved the average experimental group student from the 'frequently surrender' category to the 'occasionally, but not frequently surrender' category. Control group students showed minimal change in cognitive surrender behaviors, with the overall CSI declining only marginally from 3.77 to 3.62, suggesting that conventional instruction without specific AI-critical pedagogy was insufficient to meaningfully alter established cognitive surrender patterns. The most substantial reductions in the experimental group were observed for submitting AI text without verification (from 3.92 to 2.14, a reduction of 1.78) and accepting AI answers without questioning (from 4.08 to 2.31, a reduction of 1.77), which were precisely the behaviors that the AI Output Critique and Fact-Checking interventions were most directly designed to address. The persistence of moderate cognitive surrender scores even in the experimental group post-intervention, with all dimensions remaining above 2.0 on the 5-point scale, indicated that a single semester of intervention was insufficient to fully eliminate cognitive surrender behaviors that had been reinforced by months or years of habitual AI use patterns, and that sustained pedagogical engagement across multiple academic semesters would be required to achieve more comprehensive behavioral change. Qualitative data from student focus groups supported this interpretation, with experimental group students reporting that they had developed greater awareness of cognitive surrender risks and had adopted more critical AI use habits, but acknowledged that they continued to face temptations to take cognitive shortcuts, particularly during periods of high academic workload.

### Structural Path Model Results

A structural equation model was estimated to examine the pathways through which pedagogical intervention engagement influenced critical thinking development and the mediating role of reduced cognitive surrender. The model posited that pedagogical activity engagement (exogenous variable) influenced cognitive surrender reduction (mediator), which in turn influenced critical thinking improvement (outcome), while also allowing for a direct effect of pedagogical engagement on critical thinking improvement independent of cognitive surrender reduction. Model fit

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was acceptable (CFI = 0.93, RMSEA = 0.071, SRMR = 0.062). The standardized path coefficient from pedagogical activity engagement to cognitive surrender reduction was  $\beta = -0.61$  ( $p < 0.001$ ), indicating that higher engagement with pedagogical activities was strongly associated with greater reductions in cognitive surrender behaviors. The path from cognitive surrender reduction to critical thinking improvement was  $\beta = 0.48$  ( $p < 0.001$ ), confirming that reductions in cognitive surrender were strongly associated with improvements in critical thinking scores. The direct effect of pedagogical activity engagement on critical thinking improvement, independent of the cognitive surrender mediation pathway, was  $\beta = 0.34$  ( $p < 0.001$ ), suggesting that pedagogical activities contributed to critical thinking development through both the mediating pathway of cognitive surrender reduction and through direct pathways such as the direct practice of analytical and evaluative thinking skills during the intervention activities. The indirect effect of pedagogical engagement on critical thinking through cognitive surrender reduction was  $\beta = 0.29$  (95% CI [0.19, 0.41]), confirming partial mediation. This structural model provided a mechanistic understanding of how pedagogical interventions operated to improve critical thinking, identifying cognitive surrender reduction as a significant mediating pathway that complemented the direct skill-development effects of the pedagogical activities.

#### **DISCUSSION OF RESULTS**

The findings of this study provided compelling evidence that cognitive surrender was a pervasive phenomenon among AI-using university students in Uganda, with over 67% of pre-intervention respondents demonstrating cognitive surrender behaviors at concerning frequencies, and the overall Cognitive Surrender Inventory scores indicating that habitual intellectual passivity in the face of AI outputs was characteristic of the large majority of the study population. These findings contributed the first systematic empirical documentation of cognitive surrender prevalence in a sub-Saharan African university context and aligned with the broader international literature suggesting that AI tool proliferation was associated with increasing risks of intellectual passivity in educational settings.

The quasi-experimental evidence that targeted pedagogical interventions produced substantially larger improvements in critical thinking scores (mean gain = 8.4 points) compared to conventional instruction (mean gain = 1.9 points), combined with the large effect size (partial  $\eta^2 = 0.31$ ), provided strong justification for the investment in AI-critical pedagogy as an essential component of higher education instructional design in the AI era. The finding that AI Output Critique Exercises were the most effective individual activity was consistent with the theoretical prediction that direct, structured engagement with AI-generated content was most effective for developing the epistemic vigilance and analytical skills needed to resist cognitive surrender, as it provided students with concrete, repeated experiences of AI limitations that disrupted the perceived infallibility underlying uncritical AI acceptance.

The structural model's identification of cognitive surrender reduction as a significant mediating pathway between pedagogical engagement and critical thinking improvement had important implications for pedagogical design, suggesting that interventions should explicitly target cognitive surrender behaviors rather than focusing exclusively on general critical thinking skill development. This finding supported a model of AI-critical pedagogy as a behavioral change intervention as much as a cognitive skills development intervention, drawing on change management strategies

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from health behavior research that had demonstrated the importance of targeting specific behaviors and their underlying motivational and social reinforcers rather than attempting to change general dispositions through decontextualized skill training.

### **CONCLUSIONS**

This study concluded that cognitive surrender, understood as the uncritical and wholesale adoption of AI-generated content without independent verification, evaluation, or intellectual engagement, was prevalent among the large majority of AI-using university students in the study sample, representing a significant threat to the development of critical thinking competencies that were among the most important outcomes of higher education. The study further concluded that well-designed, structured pedagogical interventions integrating AI Output Critique Exercises, Socratic Questioning Seminars, Collaborative Fact-Checking Workshops, AI-Human Comparative Analysis Tasks, and Metacognitive Reflection Portfolios effectively promoted critical thinking development and significantly reduced cognitive surrender behaviors compared to conventional instruction. The structural model confirmed that cognitive surrender reduction was a significant mediating pathway through which pedagogical interventions enhanced critical thinking outcomes. The study concluded that in the age of generative AI, pedagogical innovation was not merely a desirable enhancement to higher education practice but a necessary response to the cognitive risks that unmanaged AI proliferation posed to intellectual development.

### **RECOMMENDATIONS**

Based on the study findings, the following recommendations were made. Higher education institutions in Uganda were strongly urged to develop and implement AI-critical pedagogy frameworks that explicitly integrated the five pedagogical activities validated in this study into the curricula of all undergraduate programs, recognizing that critical engagement with AI tools was a transferable literacy that should be developed across all disciplinary contexts.

The Ministry of Education and Sports was recommended to incorporate AI literacy and critical thinking competencies into the Uganda Higher Education Quality Standards framework, creating regulatory pressure for institutions to invest in pedagogical approaches that preserved intellectual agency in the context of AI proliferation. Lecturer professional development programs were advised to include structured modules on designing AI-critical learning activities, developing AI-resistant assessments, and facilitating Socratic dialogue in AI-augmented learning environments, recognizing that the effectiveness of pedagogical interventions was contingent on the facilitation quality of instructors.

University academic policy offices were recommended to move beyond blanket AI prohibition policies, which evidence suggested were ineffective given the accessibility of AI tools, toward nuanced AI use policies that distinguished between productive AI augmentation and cognitive surrender behaviors, and paired these distinctions with assessment designs that required demonstrations of independent reasoning rather than merely assessed written products that AI could produce.

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Future research was recommended to conduct longitudinal studies tracking the long-term persistence of critical thinking gains achieved through AI-critical pedagogical interventions, to examine the social and cultural factors shaping cognitive surrender behaviors in specific institutional and community contexts, and to investigate effective strategies for building lecturer capacity for AI-critical pedagogy across diverse resource and infrastructure contexts in Uganda and the broader East African region.

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