Human-Machine Collaboration in Education: Investigating AI's Influence on Students Analytical Skills at the Polytechnic Ibadan.

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ABSTRACT

The increasing integration of Artificial Intelligence (AI) tools into higher education is transforming the learning process, offering new opportunities while simultaneously posing challenges to students' cognitive development. Advanced AI applications now deliver efficiency, personalization, and extensive access to knowledge, thereby reshaping how learners engage with academic content. Yet, persistent concerns exist regarding the extent to which dependence on AI may compromise critical thinking, analytical skills and abilities, raising important questions about the preservation of intellectual autonomy and academic rigor. This study, to be conducted at The Polytechnic Ibadan, intends to examine the relationship between students' use of AI tools and the development of independent analytical capacities. The objectives are to explore prevailing patterns of AI utilization among students, to assess the relationship between AI reliance and levels of critical engagement, and to recommend strategies for incorporating AI in ways that strengthen rather than erode analytical skills. Fundamentally, the research is concerned with whether reliance on AI promotes improved learning outcomes or engenders intellectual dependency, thereby weakening students' ability to engage in deep, autonomous reasoning. Underpinned by constructivist learning theory, the study will adopt a mixed-methods design and purposive sampling of fifty (50) students. The anticipated findings aim to provide evidence that can inform institutional policy, curriculum reform, and teaching practices, while contributing to a better understanding of how AI technologies can be responsibly harnessed to advance learning and intellectual growth in higher education.

Keywords: Artificial Intelligence, Higher Education, Analytical Thinking, Intellectual Autonomy Polytechnic Ibadan Students

INTRODUCTION

The rise of Artificial Intelligence (AI) has redefined many aspects of human life, and education has not been left out. In recent years, AI has become a central feature of discussions on innovation in higher education, offering new ways of teaching, learning, and assessment. Holmes, Bialik, and Fadel (2019) explained that AI technologies have the capacity to transform learning by personalizing content, enhancing student engagement, and improving academic performance. Similarly, Chen, Chen, and Lin (2020) pointed out that AI applications such as adaptive learning platforms, automated assessments, and virtual assistants are increasingly becoming part of mainstream education across the globe.

However, while these opportunities are attractive, concerns have been raised about the unintended effects of AI on student development. Facione (2020) emphasized that critical thinking remains the foundation of higher education, and any trend that undermines it threatens academic growth. Luckin, Holmes, Griffiths, and Forcier (2016) also warned that over-reliance on AI may reduce students' ability to think independently and solve problems creatively. Selwyn (2019) added that the automation of academic tasks, if unchecked, risks eroding deeper learning skills that are vital for life beyond the classroom.

Other scholars have expressed similar mixed views. Roll and Wylie (2016) described AI in education as both an "evolution and revolution," stressing that while it expands access and efficiency, it also creates risks of dependency. Hwang and Tu (2021) showed, in their study of AI use in mathematics, that AI enhances personalized learning but leaves open questions about its impact on higher-order skills. UNESCO (2021) has also called for policymakers to ensure AI complements rather than replaces human interaction, especially in developing countries where digital divides persist.

For Africa, the debate takes on additional layers. Nchindila (2020) observed that AI can widen access to learning in African universities but warned that infrastructural and digital literacy challenges limit its impact. In Nigeria, Ifijeh and Yusuf (2020) highlighted similar obstacles, such as poor funding, lack of awareness, and weak infrastructure, which slow down adoption of AI in universities despite its potential. These concerns are particularly relevant for polytechnics, where students are expected to combine technical competence with analytical and problem-solving skills.

Vieriu and Petrea (2022), in their review of AI adoption in European institutions, stressed the need for a balanced approach that preserves human interaction while leveraging the benefits of technology. Zawacki-Richter, Marín, Bond, and Gouverneur (2019) also noted that while AI can improve administrative and instructional processes, little attention has been paid to how it affects students' intellectual autonomy. These findings underline the importance of examining how AI is shaping the analytical abilities of students in different contexts.

For The Polytechnic Ibadan, Oyo State, the issue is particularly timely. Students increasingly have access to AI tools such as chatbots, translation software, and automated writing assistants, which they use for assignments, projects, and even daily study. While these tools can support learning, the fear is that excessive dependence on them might weaken students' analytical capacity and reduce the independent thinking skills that polytechnic education is designed to build.

This study, therefore, investigates the relationship between AI usage and the development of analytical skills among students of The Polytechnic Ibadan. The research aims to provide evidence on whether AI is being used in ways that support or undermine intellectual growth. Findings will be valuable for informing institutional policy, guiding lecturers on teaching practices, and shaping curriculum reforms that promote the responsible use of AI while safeguarding critical thinking and problem-solving abilities.

Statement of the Problem

Artificial Intelligence (AI) is increasingly transforming higher education through tools such as adaptive learning platforms, intelligent tutoring systems, and AI-powered writing assistants (Holmes et al., 2019; Chen et al., 2020). While these technologies promise personalized learning and improved academic outcomes, scholars caution that over-reliance on them may weaken students' critical thinking and problem-solving abilities (Facione, 2020; Luckin et al., 2016; Selwyn, 2019).

In Nigeria, where polytechnic education emphasizes technical competence and analytical skills, this concern is particularly relevant. Studies (Ifijeh & Yusuf, 2020; Nchindila, 2020) have shown that although AI adoption is growing, infrastructural and pedagogical challenges persist, and little attention has been paid to its effect on students' intellectual development. At The Polytechnic Ibadan, students increasingly depend on AI tools for assignments and study support, raising fears of academic dependency and reduced analytical engagement.

Despite global research on AI in education (Roll & Wylie, 2016; Zawacki-Richter et al., 2019; Vieriu & Petrea, 2022), there is limited empirical evidence from Nigerian polytechnics on how AI shapes students' analytical capacity. This gap underscores the need for the present study, which investigates the relationship between AI use and analytical skill development among students of The Polytechnic Ibadan.

Research Questions

- What are the major AI tools used by students of The Polytechnic Ibadan in their academic work?
- To what extent do students rely on AI tools for learning and assignments?

- How does AI usage influence students' analytical and problem-solving skills?
- What strategies can ensure that AI supports rather than undermines students' intellectual development?

Research Objectives

- To identify the major AI tools used by students in their academic activities.
- To assess the extent of students' reliance on AI tools for learning and assignments.
- To examine the effect of AI usage on students' analytical and problem-solving skills.
- To propose strategies for responsible integration of AI in polytechnic education.

Research Hypotheses

1. H_{01}: There was no significant relationship between the use of Artificial Intelligence (AI) tools and the development of analytical skills among students of The Polytechnic Ibadan.

H_{11}: There was a significant relationship between the use of Artificial Intelligence (AI) tools and the development of analytical skills among students of The Polytechnic Ibadan.

2. H_{02}: There was no significant difference in the analytical skills of students who frequently relied on AI tools and those who used them minimally.

H_{12}: There was a significant difference in the analytical skills of students who frequently relied on AI tools and those who used them minimally.

3. H_{03}: There was no significant influence of AI-powered learning platforms on students' ability to solve academic problems independently.

H_{13}: There was a significant influence of AI-powered learning platforms on students' ability to solve academic problems independently.

4. H_{04}: There was no significant impact of reliance on AI tools on students' critical thinking abilities at The Polytechnic Ibadan.

H_{14}: There was a significant impact of reliance on AI tools on students' critical thinking abilities at The Polytechnic Ibadan.

The scope of the study

1. Geographical Scope – The study was restricted to The Polytechnic Ibadan and did not extend to other institutions of higher learning within or outside Oyo State.
2. Population Scope – Only 50 students participated in the study due to time, financial, and logistical constraints. While this number may not fully represent the entire student population, it offered valuable indications of trends in AI usage and its effect on learning.
3. Content Scope – The study focused exclusively on students' interaction with AI-powered tools such as intelligent tutoring systems, adaptive learning platforms, and virtual assistants. It examined how reliance on these technologies influenced their analytical and problem-solving abilities. Other aspects of education, such as emotional, social, or psychological effects of AI, were not covered.

By setting these boundaries, the study was able to generate findings that were both specific and manageable, while also providing a foundation for further research on the role of AI in Nigerian polytechnics.

Operational Definition of Terms

1. Artificial Intelligence (AI): Computer-based systems and applications, such as intelligent tutoring systems, adaptive learning platforms, and virtual assistants, designed to simulate human intelligence and support learning processes among students.

2. Analytical Skills: The ability of students to critically examine, interpret, and evaluate information in order to solve problems, make decisions, and generate independent ideas.
3. Critical Thinking: A higher-order cognitive process that involves reasoning, reflection, and judgment, enabling students to question assumptions and arrive at logical conclusions beyond AI-generated outputs.
4. Reliance on AI Tools: The extent to which students depend on AI-powered applications for learning tasks, problem-solving, and academic decision-making, sometimes at the expense of independent reasoning.
5. Student Engagement: The degree of active participation, motivation, and interaction exhibited by students in the learning process, whether enhanced or hindered by AI applications.
6. The Polytechnic Ibadan: A tertiary institution located in Oyo State, Nigeria, which served as the case study for this research.

LITERATURE REVIEW

Artificial Intelligence in Education: Global Perspectives

Artificial Intelligence (AI) is changing the way education works across the world. From intelligent tutoring systems to adaptive learning platforms and virtual assistants, AI tools are increasingly being used to support student learning and engagement. These technologies are praised for giving personalized feedback, saving time on routine tasks, and encouraging students to take more control of their learning (Holmes, Bialik, & Fadel, 2019; Luckin et al., 2016).

At the same time, there are concerns about how AI might affect students' thinking skills. Facione (2020) stresses that higher education students need strong problem-solving and critical reasoning abilities. Luckin et al. (2016) point out that relying too heavily on AI could reduce students' capacity to think independently, potentially weakening their intellectual autonomy. Vieriu and Petrea (2022) argue that AI should complement, not replace, traditional teaching methods, ensuring that students remain actively involved in learning.

AI in Nigerian Higher Education: Current Landscape

In Nigeria, the use of AI in higher education is still at an early stage. Although some institutions have started offering AI-related courses and training, the routine use of AI tools in teaching and learning is limited. Ukala (2025) studied the integration of AI in Technical and Vocational Education and Training (TVET) programs in Abia State. The study found that while there is interest in AI, challenges such as poor infrastructure, lack of trained staff, and resistance to change have slowed progress.

Similarly, Augustus-Daddie et al. (2025) examined the use of AI as a teaching tool in Nigerian institutions and identified barriers including limited access to technology, low digital literacy among students and lecturers, and the absence of clear policies to guide AI adoption. These findings highlight the need for a careful approach to AI in Nigerian higher education—one that balances technology with practical, pedagogical, and policy considerations.

Constructivist Learning Theory and Its Relevance

Constructivist learning theory suggests that students learn best when they actively construct knowledge, rather than just memorizing facts (Piaget, 1972; Vygotsky, 1978). In practice, this means learning through experience, reflection, and problem-solving.

When we look at AI in education through this lens, the key question becomes: Does AI help students think for themselves, or does it make them dependent? AI can provide guidance, examples, and feedback that support learning, but the benefit depends on how students engage with it. If students use AI to explore, analyze, and test ideas, it reinforces constructivist principles and strengthens their analytical skills. On the other hand, if AI is simply used to give ready-made answers, it may limit critical thinking and independent reasoning.

Using constructivist theory as a guide, this study focuses on how human–machine collaboration affects students' ability to think analytically and whether AI encourages active, reflective learning rather than passive consumption.

The Gap in Literature

While many studies show that AI can make learning more efficient and personalized, there is little research on how collaborating with AI affects students' independent thinking, especially in Nigerian polytechnic settings. Most prior research looks at universities in developed countries or treats AI as just a support tool, not an active learning partner. This study addresses that gap by examining students at The Polytechnic Ibadan and exploring both the opportunities and challenges AI presents for building analytical skills.

METHODOLOGY

This study employed a quantitative, non-experimental research design utilizing a correlational technique. This method was used when the objective is to describe the status of the situation as it existed at the time of the study and explore the causes of a particular phenomenon. In correlation research, it involves collecting data in order to determine whether the degree of a relationship exists between two more quantifiable variables (Gay et al., 2006). This survey dealt on quantitative data about the said phenomenon. The quantitative aspect is an appropriate schedule for gathering the data, designed for the target respondents to answer the questions. The process of gathering the data was based on the use of the questionnaire. The focus of the study was to examine how human–machine collaboration (AI use) influences students' analytical skills at The Polytechnic Ibadan.

Population and Sample

The respondents were selected through purposive sampling and a complete enumeration of 50 participants, all of whom are students from National diploma and Higher Natonal Diploma of the Polytechnic Ibadan. These students were considered ideal respondents due to their active engagement with artificial intelligence (AI) and their participation in diverse academic writing tasks within the classroom setting, including essays, research papers, and analytical assignments, showcasing their comprehensive understanding and involvement in the subject matter. The distribution of respondents across grade level are outlined in Table 1 which are students from five Faculties (FSC, FFMS,FBCS, FENG and FES) at The Polytechnic, Ibadan for the school year 2025.

Instrument:

Data will be collected via a 30-item structured questionnaire covering demographics, AI usage influence on analytical skills, challenges, and recommendations. Questions include Likert scales, multiple-choice, and open-ended items.

Statistical Tool

The following statistical tools were utilized for the data analysis and interpretation.

Mean. This statistical tool was used to determine the level of artificial intelligence (AI) reliance and students' analytical writing among students of the Polytechnic ibadan.

Pearson (r). This statistical tool was used to determine the significance of the relationship between artificial intelligence (AI) usage and students' academic writing among students of the Polytechnic ibadan

Inferential statistics: Pearson correlation and ANOVA/t-tests to examine relationships between AI collaboration and analytical skills.This statistical tool was used to determine the influence of artificial intelligence (AI) usage and students' academic writing among students of the Polytechnic ibadan

Data Collection:

Questionnaires was administered with informed consent, and confidentiality. Data collection was conducted within two weeks.

RESULTS

Table 1 showing the data of the respondents

Variables	Frequency (n)	Percentage (%)
Institutions		
The Polytechnic Ibadan	**50**	**100**
Age group in years		
18-21	**14**	**27**
22–25	**18**	**37**
26-29	**12**	**24**
30+	**6**	**12**
Sex		
Female	**27**	**54.0**
Male	**23**	**46.0**
Faculty		
FBCS	**14**	**28**
FSC	**11**	**22**
FFMS	**10**	**20**
FENG	**9**	**18**
FES	**6**	**12**
LEVEL		
ND I	**13**	**26**
ND II	**12**	**24**
HND I	**13**	**26**
HND II	**12**	**24**

Interpretation: The table shows the age of the respondents. Out of 50 respondents 27% belonging to the age group of 18-21, 24% are 26-29yrs, while highest responded are 22-25yrs with 37%

Level of Artificial Intelligence (AI) Usage

Shown in Table 2 are the mean scores for the indicators of artificial intelligence (AI) reliance among students of the Polytechnic Ibadan has an overall mean of 3.98 and is described as high with a standard deviation of 0.56. The high level could be attributed to the high rating given by the respondents in all indicators. This entails that the respondents' responses to artificial intelligence (AI) usage is positive in terms of satisfaction, AI literacy, relevance of AI, and lack more analytical skills

The cited overall mean score was the result obtained from the following computed mean scores from highest to lowest: 4.03 or high for AI reliance with a standard deviation of 0.57; 4.00 or high for satisfaction with a standard deviation of0.57; 3.96 or high for confidence with a standard deviation of 0.54; and 3.91 or high for relevance of AI with a standard deviation of 0.57.

Table 2. Artificial Intelligence (AI) Practice

Indicators	Mean	SD	Descriptive Equivalent
Problem-Solving Skills	4.00	0.57	High
Reliance on AI	4.91	0.28	High
Confidence	3.96	0.54	High
AI Literacy	4.03	0.57	High

Level of Students' Analytical skills

Shown in Table 3 are the mean scores for the indicators of students' analytical skill in The Polytechnic, Ibadan with an overall mean of 4.04 and described as high with a standard deviation of 0.57. The high level could be attributed to the high rating given by the respondents in all indicators. This entails that the respondents' responses to the level of students' academic writing are negative in terms of perceived usefulness, and attitude towards analytical thinking.

The cited overall mean score was the result obtained from the following computed mean scores from highest to lowest: 4.08 or high for attitude towards usage with standard deviation of 0.58; 4.08 or high for perceived usefulness with standard deviation of 0.56; and 3.95 or high for perceived ease of analytical intelligent with standard deviation of 0.58.

Table 3. Level of involvement in Analytical thinking

Indicators	Mean	SD	Descriptive Equivalent
Human–Machine Collaboration	4.08	0.56	High
Influence on Analytical & Problem-Solving Skills	3.95	1.58	Low
Challenges of Human–Machine Collaboration	1.08	2.23	Low
Overall	4.04	0.58	High

Significance on the Relationship between Artificial Intelligence (AI) Usage and Students' Analytical skills

One crucial purpose of this study is to determine whether or not artificial intelligence (AI) usage has a significant relationship with students' analytical skills among the polytechnic Ibadan students. Pearson r was used to determine the correlation between the two variables. The results revealed that artificial intelligence (AI) usage and students' analytical skills has a significant relationship. This result is due to a p – value of <.001, which is less than the 0.05 p-value. Hence, this leads to the decision that the null hypothesis, which stated that there is significant relationship between artificial intelligence (AI) usage and students' analytical skills among students of The Polytechnic, Ibadan is accepted. Furthermore, Pearson's R value which is 0.024 means that there is a high correlation between artificial intelligence (AI) usage and students' analytical skills.

Pearson correlation and ANOVA/t-tests Analysis of The Influence of Artificial Intelligence (AI) and Students' Analytical skills

Using the pearson/t-test Analysis, the data revealed that the influence of artificial intelligence (AI) usage to the students' analytical thinking has an f-value of 119.185 and corresponding significance p-value of < .001 which was significant. This means that the level of artificial intelligence (AI) usage influences the students' logical skills since the probability is less than 0.05. The R square of 0.591 implies that 59.1% of the students' academic writing is influenced by the artificial intelligence (AI), while 40.9% remaining were not covered by the study and is influenced by other factors.

The findings of this research benefited to several groups:

- Students – by creating awareness of both the benefits and risks of over-reliance on AI, the study will encourage responsible use of technology to strengthen, rather than weaken, their critical thinking and problem-solving abilities.
- Lecturers and Academic Staff – the study will provide insights into how students are using AI tools and how these tools affect learning outcomes. This will help lecturers design teaching methods that integrate AI responsibly while preserving independent learning skills.
- Institutional Management – the results will guide The Polytechnic Ibadan in shaping policies on AI adoption, curriculum design, and student assessment, ensuring that technology is used to enhance, not replace, intellectual development.
- Nigeria's Higher Education Sector – by focusing on a Nigerian polytechnic, the study contributes empirical evidence to a context where little research has been done on AI's impact on analytical skills. The findings may also serve as a reference point for other polytechnics and universities across the country as they grapple with similar challenges.

DISCUSSIONS

Level of Artificial Intelligence (AI) Usage Presented in the previous chapter were the results of the level of artificial intelligence (AI) dependency. It was reported as high, indicating a significant presence of artificial intelligence (AI) usage among the students. Upon examining the research conducted by Buenano-Fernandez et al. (2019), it was found that the study on the use of artificial intelligence (AI) in academic works revealed a positive increase in students' learning outcomes which is affecting their logical reasoning. Students expressed satisfaction with artificial intelligence (AI) tools, finding them helpful in enhancing their writing skills. The high usage of artificial intelligence (AI) emphasized students' recognition of its importance in improving their overall academic writing proficiency. Additionally, students demonstrated confidence in utilizing artificial intelligence (AI) for their academic tasks and showcased proficiency in artificial intelligence (AI) literacy by understanding and effectively navigating artificial intelligence (AI) concepts. This collective engagement demonstrated a comprehensive embrace of satisfaction, the relevance of intellectual autonomy and AI deepen among the students.

Concerning satisfaction, the level of artificial intelligence (AI) usage among students is also high. This indicates consistently reliance of Ai, reflecting their contentment with various applications and tools of artificial intelligence (AI) in their educational journey. In line with this, it substantiates the assertions made by Perez (2023) stating that artificial intelligence (AI) has the potential to provide a wide range of benefits for education and can also compliment analytical skills. Positive responses suggest that students find artificial intelligence (AI) to be a valuable asset, contributing to their overall learning experience, motivation, and commitment to academic tasks with negative effects on their analytical and native intelligence.

Level of Students' analytical skills

The level of students' analytical skills at The polytechnic, Ibadan, as reflected by the respondents, attests to a high influence of AI. This signifies that the results of the research conducted among the students were negative, indicating that a high level of students' academic writing is crucial to AI. The study conducted validates the statement made by Fang (2021) that writing in an academic style with logical reasoning is crucial for academic achievement and is required for studying academic disciplines.

Analytical is viewed as a means of producing, codifying, conveying, assessing, renovating, teaching, and acquiring knowledge with personal ideologies. This aligns with the viewpoint presented by Writernjerih (2023), who argues that academic writing forms the foundation of higher education and scholarly endeavors. By honing these skills, individuals can effectively contribute to their field of study, engage in intellectual conversations, and make significant contributions to society. Western Washington University (2023) emphasizes that every academic writer employs rhetorical moves such as Grounding, Forwarding, and Countering. This perspective is further reinforced by the study conducted by Knight et al. (2020), which

highlights the importance of these rhetorical moves across various academic writing styles, including essays and research abstracts, as well as in forms of writing that reflect on experiential learning.

Significance on the Relationship between Artificial Intelligence (AI) and Students' Analytical skills

The present study unveils a significant relationship between artificial intelligence (AI) and students' analytical skill at The polytechnic,Ibadan. This suggests that artificial intelligence (AI) usage influences students' analytical skills, as evidenced by the provided data. The findings of this study align with Malik et al.'s (2023) research, affirming a notable relationship between these variables, where artificial intelligence (AI) usage significantly influences students' analytical aids. This is consistent with Kukulska-Hulme's (2019) proposition that the utilization of artificial intelligence (AI) mobile apps, as a modern technology, profoundly impacts students' learning, effectively integrating technology to enhance learners' motivation and autonomy in analytical skills.

Furthermore, the study implies that students' academic writing may depend on artificial intelligence (AI) usage, supporting Fitria's (2021) findings that artificial intelligence (AI) has the potential to enhance the quality of academic writing. Alharbi (2023) also supports this notion, asserting that artificial intelligence (AI) provides valuable support in various aspects of academic writing, including language correction, grammar checking, and proofreading. Wei and Chou (2020) highlight the critical role of artificial intelligence (AI) in generating ideas, expressing thoughts, formulating writing strategies, and fostering writing willingness, aligning with the current study.

Multiple Regression Analysis of the Influence of Artificial Intelligence (AI) Usage and Students' Academic Writing

The regression coefficient, designed to assess the significant influence of Artificial Intelligence (AI) Usage on students' academic writing, indicates that three out of the four domains—namely AI literacy, relevance of AI, and confidence—have significant influence on students' academic writing. Conversely, satisfaction was found to be non-significant in influencing students' academic writing.

The results of the study align with research conducted by Gayed et al. (2022), supporting the positive impact of artificial intelligence (AI) usage on students' academic writing. Additionally, the findings affirm the value of artificial intelligence (AI) highlighted by Makarius et al. (2020), particularly in providing timely feedback and improving academic writing skills. Lameras and Arnab's (2022) investigation into the use of artificial intelligence (AI) among students in academic writing also complements the study's results, showcasing a positive impression toward their grades.

CONCLUSION

Conclusions are drawn based on the results of the study. Which indicated that human–machine collaboration has the potential to significantly enhance students' analytical skills at The Polytechnic Ibadan when implemented thoughtfully. The key lies in balancing AI-driven efficiency and guidance with intentional cultivation of independent reasoning, critical evaluation, and ethical awareness. By designing curricula and assessment practices that foreground process, provenance, and reflection; investing in faculty development; and ensuring equitable access and robust data governance, The Polytechnic Ibadan can harness AI to elevate analytical competencies while safeguarding academic integrity and inclusivity.

The study concludes that the level of influence of artificial intelligence (AI) usage among students in The Polytechnic Ibadan is high, as well as its indicators, namely AI satisfaction, reliance of AI, confidence, and AI literacy. Furthermore, the overall level of students' analytical skills among students in The Polytechnic Ibadan is also high, as well as all three domains namely perceived usefulness, perceived ease of use, and attitude towards usage. Moreover, the findings reveal that there is a significant relationship and a high correlation between artificial intelligence (AI) usage and students' analytical skills. Moreover, the domains of artificial intelligence (AI) that significantly influence students' academic writing are the relevance of AI, reliance, and

AI literacy. However, satisfaction, as a domain of artificial intelligence (AI) usage, has no significant influence on students' analytical skills

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