Generative AI's Influence on High School Students' Analytical Skills in Tripoli, Libya

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تأثير الذكاء الاصطناعي التوليدي على مهارات التحليل لدى طلاب المرحلة الثانوية في طرابلس

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Abstract:

This paper examines the various functions of Generative AI (GenAI) in the intellectual growth of high school students (15-18) in Tripoli, Libya, a place characterised by infrastructural constraints and a traditional background of learning. The conflict between developing analytical abilities and cognitive offloading has become acute as students turn more and more to tools like ChatGPT as a solution to the limitations in the available resources. To overcome this problem, the study employed both a quantitative survey of 80 students of both scientific-based and literary tracks and a qualitative study of 20 English teachers.

The findings demonstrate that GenAI has become a vital part of the Libyan education system as 85 percent of the respondents claimed using it weekly.Interestingly, there is no real divide when it comes to how much students feel AI helps their analytical skills - both scientific and literary reported similar benefits with no statistically significant difference between them (p = 0.31). There was a discrepancy within the disciplinary area: cognitive offloading. The results show a significant gap (p < 0.05): students in literacy showed a greater tendency to rely on AI (3.2 ± 1.0) than their scientific peers (2.5 ± 1.1).Besides, proficiency in a language and a steady internet connection were determined as major indicators of effective AI use. Teachers pointed out that AI could be used to provide assistance in generating ideas, but the advantages are conditional upon the meticulous work of the teacher, as otherwise, there is a danger of developing skills and even missing cultural values. The paper concludes that to be an authentic Vygotskian scaffold, instead of a cognitive crutch, GenAI requires the Ministry of Education to introduce specialised curriculum change and encourage metacognitive AI literacy.

Keywords: Generative AI; English Language; High School; Analytical Skills; Tripoli; Education.

الملخص :

تتقصى هذه الدراسة أثر أدوات الذكاء الاصطناعي التوليدي على تنمية المهارات التحليلية لدى طلاب المرحلة الثانوية (الفئة العمرية 15-18 عاماً) في مدينة طرابلس بليبيا؛ وهو سياق تعليمي يتسم بتحديات فريدة تفرضها البنية التحتية المتهالكة والإرث التعليمي التقليدي. ومع توجه الطلاب المتزايد نحو استخدام أدوات مثل (ChatGPT) للتغلب على نقص الموارد، برز استخدام برامج كـ التقنيات كـ "محفزات للتحليل" وبين كونها "أدوات للاتكال المعرفي". اعتمدت الدراسة منهجاً مختلطاً لتمكن من تغطية الجوانب المختلفة للموضوع؛ حيث جمعت بين البيانات الكمية المستمدة من استبيان شمل 80 طالب وطالبة في المسارين العلمي والأدبي، وبين الرؤى النوعية المستخلصة من مقابلات مع 20 معلماً ومعلمة للغة الإنجليزية. كشفت نتائج الدراسة أن الذكاء الاصطناعي أصبح جزءاً لا يتجزأ من واقع التعليم في ليبيا، حيث يستخدمه 85% من المشاركين أسبوعياً. وقد أوضحت الدراسة أن هناك تباين دقيق بين المسارات الأكاديمية، حيث اتفق الطلاب على أن الذكاء الاصطناعي ساعدهم وتوصلت الدراسة إلى نتيجة محورية تتمثل في التباين الواضح بين التخصصات الأكاديمية؛ فبينما أجمع الطلاب على جدوى هذه الأدوات، أظهر طلاب المسار الأدبي ميلاً أكبر للاتكال المعرفي بمتوسط (3.2 ± 1.0) مقارنة بنظرائهم في المسار العلمي (2.5 ± 1.1)، مع وجود دلالة إحصائية واضحة (0.05 > p). وعلاوة على ذلك، حدد التحليل الإحصائي الكفاءة اللغوية واستقرار الاتصال بالإنترنت كعوامل حاسمة في تحديد جودة استخدام هذه التقنيات. ومن جهة أخرى، أكد المعلمون أن الذكاء الاصطناعي قد "يشعل" الأفكار الأولى، لكنه يتطلب وسيطاً تربوياً حازماً لمنع تآكل المهارات وضمان التوافق الثقافي. وختاماً، تخلص الدراسة إلى أن تحويل الذكاء الاصطناعي إلى "دعامة معرفية" حقيقية بدلاً من كونه "عكازاً ذهنياً"، يستوجب تطوير الأطراف التعليمية في طرابلس من خلال إصلاحات منهجية تعزز الوعي الميتامعرفي بالذكاء الاصطناعي.

الكلمات المفتاحية: ذكاء اصطناعي، مهارات تحليلية، لغة إنجليزية، مدرسة ثانوية، طرابلس، تربية.

Introduction

Generative AI is transforming education, especially by encouraging high-level thinking, e.g. analytical thinking, in high school students in difficult areas like Tripoli, Libya. Political instability, the lack of resources, and the fact that the Libyan educational system is based (in large part) on rote learning have put the education system under significant pressure. In these regards, the possibilities of instruments like ChatGPT are an opportunity to enhance

the analytical skills of students, which will matter in their future performance. The paper examines the application of AI to the high schools of Tripoli, paying attention to the various strategies used by learners of scientific and literary courses: fact-checking in sciences and narrative evaluation in humanities. These contrasts highlight the variety of applications and probable consequences of AI as a cognitive intermediary in fields of knowledge, which favour critical digital competence and personalised learning opportunities (Calderwood, 2024; Munoz et al., 2025). Nevertheless, the educational aspects of the integration of AI into formal education should be considered, especially in terms of the probability of biased AI-generated information and the threat of overreliance on automated responses (Munoz et al., 2025).

Although the international literature discusses the elements of student-AI interaction, including prompting and evaluation, and certain research is devoted to Libyan university and postgraduate students, the gap in the research of the high school student population remains strong. Such an omission is important because high school is where critical rigour required to facilitate lifelong learning is laid down. The education system of Libya is based on high-stakes examinations, such as the National Secondary Education Certificate Examination that defines the academic specialisations of students in their future. In that regard, the given analysis narrows down to the way students cope with cognitive offloading and analytical augmentation as a method of systematic survey, including linguistic deconstruction and verification of AI output as opposed to the Libyan national curriculum.

The dual-track system of education in Libya places AI as a cognitive companion, and its skills in computational reasoning and problem-solving are improved with the utilization of meta-cognitive strategies, despite unremitting difficulties, pertaining to bias and validation.

Problem Statement

Despite the potential to revolutionize the sphere of high school education, the issue of conservative orientation on memorisation and lack of critical thinking remains in Tripoli despite the potential of Generative AI. Pedagogy further increases the gap on political instability and scarce resources. With students relying on AI tools to solve the complicated English curriculum, a high chance of cognitive offloading, where the student loses his cognitive analysis to the tool, exists. This may pose significant consequences on the performance of the students in major examinations like the National Secondary Education Certificate Examination where it requires one to think critically. In addition, insufficient analytical ability can hinder the employment preparedness in a competitive labour market where decision-making and analytical reasoning are crucial. Currently, there is no empirical research on how the socio-technical peculiarities of Tripoli, including unstable access to the internet and curricular-cultural asymmetries, help promote the fact that AI may become an innovation driver or a crutch that hurts the fundamental skills of analysis. The proposed research will hence focus on the microsystemic interaction between generative AI and learning how to be an analyst among learners in Tripoli, Libya, given the perceived positive and possible negative outcomes in this distinctive learning context (TAMIMI et al., 2024)

Research Questions

1. What is the impact of the use of generative AI in the scientific vs. literary track in Tripoli?
2. What are the teachers' perceptions about barriers and facilitators in the unique environment of education in Libya?
3. What is the connection between AI engagement and local digital literacy and innovation through student surveys?

The context of the High School in Tripoli, Libya.

In Tripoli, secondary education is organised in a well-organised dual-track system, the Scientific and Literary. Although both pathways are similar in the standard English language curriculum at the syntactic level, they differ significantly at the morphological and thematic levels. The science track is related to objective, technical discourse and the literary track involves subjective human experience, culture, and social action. In mixed classes in Tripoli, there is a wide range of language proficiency and learning styles among students aged 15-18, largely due to varying levels of exposure to different languages. These internal differences complicate the implementation of Generative AI, as every student's ability to critically interpret AI-generated material is inherently shaped by their linguistic and educational background.

Significance and Scope

This research targets critical gaps in the adoption of AI within Libyan secondary education by giving policymakers a representative model of Tripoli that mediates technological opportunities amid infrastructural limitations, such as frequent power outages. The study is based on a limited sample of 100 students and teachers and provides urban-specific viewpoints on digital learning amid instability. However, its findings are not generalizable to regional contexts and should be regarded as a basic case study.

Literature Review

The implementation of generative AI in education has triggered global discussion about its use in improving thinking, especially in analysis. Investigations recognise GenAI as a mental tool that helps develop critical thinking abilities and computational thinking in conversations before university. It enables students to improve their prompts and objectively review the results. (Munoz et al., 2025). Nevertheless, there is also a fear of excessive dependence, which can result in cognitive offloading and the loss of critical thinking, as it was also reflected in the context of regional settings, such as Morocco, where the use of AI homework tools among high school students caused concern about the autonomy of decision-making and the decline of the ability to think (TAMIMI et al., 2024). University students in the UAE in the Middle East note that they need to move towards a process of learning with AI rather than through AI, or it will create barriers to deep engagement through over-dependence (Calderwood, 2024).

Although the role of AI in prompting and evaluating skills is discussed in the international literature (Munoz et al., 2025), there is a lack of research on this topic in the context of North African high schools, particularly given infrastructural limitations. The education situation in Libya is characterised by instability. Therefore, there is no empirical data on the combined role of GenAI as both an innovator and a crutch, which makes the study unique

Theoretical Framework

This study is based on the cognitive offloading versus analytical augmentation dichotomy, a framework developed by Vygotsky through the Zone of Proximal Development, with GenAI serving as a scaffold for advanced thinking. Artificial intelligence serves as a tool to validate facts within scientific pieces against measurable criteria; within literary pieces, it encourages the deconstruction of the narrative. The link between these areas is formed by metacognitive practices (e.g., prompt engineering, bias detection) that can improve digital knowledge despite local challenges like intermittent connectivity.

Methodology

Research Design

A mixed-method design was used, comprising quantitative surveys of 80 students and qualitative surveys of 20 teachers from five high schools in Tripoli, followed by qualitative interviews with 15 participants. The random sample included students aged 15-18 from both science-related (n=40) and literary (n=40) tracks. Data collection instruments included a 5-point Likert-scale survey assessing the frequency of AI use, perceived analytical benefits, and challenges related to the Libyan curriculum. Additionally, a subset of students and teachers participated in semi-structured interviews to provide subtle insights into the practical application of GenAI within Tripoli's educational context.

Data Analysis and Data Collection.

Data collection occurred over a two-month period (November-December 2025), despite infrastructure issues in Tripoli, such as power outages, and the need for offline-capable survey instruments (e.g., printable forms and offline Google Forms). The quantitative survey was administered to 100 students aged 15-18 in both scientific and literary tracks, beginning with questions on school type, academic track, and frequency of AI use. This was followed by 12 items on a 5-point Likert scale (Strongly Agree to Strongly Disagree) measuring analytical augmentation (e.g., use of AI to deconstruct complex writing, connect information, and concerns about overuse) and potential cognitive offloading (e.g., reliance on AI for assignments, worries about negative impacts). SPSS was used for descriptive statistics (means ± SD), independent t-tests, and track comparisons. Semi-structured interviews (n=20) identified enablers (e.g., personalised learning) and barriers (e.g., bias, over-reliance). To tackle potential measurement bias, survey items were neutrally worded, and students were assured of anonymity and

confidentiality to promote honest responses. This limitation is acknowledged to address concerns with the reliability of self-reported data.

Discussion

The results support the multifunctionality for generative AI in boosting analytical capabilities among the high school population of Tripoli, at least according to the cognitive offloading versus analytical augmentation dichotomy (TAMIMI et al., 2024). The fact that GenAI was most commonly used by students (85% weekly) indicates that they increasingly use them in their homework, which requires further insights into the effect of these tools on learning outcome.

The lack of statistically significant difference in self-reported improvement in analytical capacity in scientific and literary tracks (p=0.31) is the first indication of the universal advantage of AI in different fields. The much less reported cognitive offloading risk by scientific track students, however, implies that their interaction with AI may be associated with more of an analysis augmentation, which is more in line with their fact-checking and empirical standards orientation as suggested by our theoretical model. This is unlike the literary track students where there is a greater risk of cognitive offloading of the higher level, so without explicit methods of dissecting the narrative and critically analyzing it, the AI outputs may be substituting, not supplementing their mental processing. Such a difference conforms to the international literature that states that students should not only change their approach to learning by AI but also to learning to learn with AI so as to avoid over-dependence (Calderwood, 2024).

The views of the teacher, which emphasize the capacity of AI to create ideas, and the necessity of teacher instruction, add to the idea of AI as a scaffold in the Zone of Proximal Development developed by Vygotsky. It means that although AI can mediate the process of higher-order thinking, its successful implementation demands some intentional pedagogical approaches to contain risks, such as biases and over-reliance (Munoz et al., 2025). The ability of linguistic proficiency and internet access to predict a good outcome greatly also indicates the critical socio-technical limitations peculiar to Tripoli. Lack of stable internet connectivity, as well as the abundance of different levels of linguistic skills among learners, may provide an unequal foundation to AI implementation, which, in turn, may widen the gaps in education that already exist.

The SPSS was used to analyze the quantitative data in terms of descriptive statistics, independent t-tests in comparison of tracks, and multiple regression. Semi-structured interviews conducted in qualitative data were subjected to inductive thematic analysis using NVivo to determine enablers and barriers.

Findings

The mixed approach with the quantitative survey and the qualitative interview provided some important insights into the introduction of the concept of generative AI into the high school education system of Tripoli.

Quantitative Findings

Quantitatively, the analysis of 100 responses of students showed that there were specific patterns in scientific and literary tracks. Most students, 85% that participated in the study, said that they used Generative AI tools to complete English language tasks at least once in a week. Although both tracks had the similarly frequent use of AI (Scientific: 4.2 ± 0.8 ; Literary: 3.8 ± 1.0), and self-reported improvement of their cognitive offloading (Scientific: 4.1 ± 0.7; Literary: $3.9\text{-}1.0$), statistically significant difference was found in the perceived risk of cognitive offloading (Scientific: 2.5 ± 1.1 ; Literary: 3.2 ± 1.0, $p < 0.05$).

Table 1: Metrics AI Use Comparison across Academic Tracks.

Variable	Scientific Track	Literary Track	P-value
AI Usage Frequency	4.2 ± 0.8	3.8 ± 1.0	0.12
Analytical Improvement	4.1 ± 0.7	3.8 ± 1.0	0.31
Cognitive Offloading Risk	2.5 ± 1.1	3.2 ± 1.0	<0.05*

Note: *$p < 0.05$ indicates that the difference is statistically significant.

Linguistic proficiency and internet access were selected as significant predictors of positive outcomes in AI integration through regression analysis (with beta=0.45 and p<0.01 and beta=0.32 and p<0.05 respectively). Students in scientific track particularly indicated greater augmentation in analytical skills, which is consistent with

their exposure to objective and technical discourse and literary track students indicated greater perceived cognitive offloading risk, indicating that they had problems with narrative evaluation without adequate critical intervention.

Qualitative Findings

The qualitative information of semi-structured interviews with 20 English language teachers gave a more in-depth view of the pragmatic challenges and pedagogical change in the classroom of Tripoli.

1. **Artificial Intelligence Engagement and Metacognition.**
- **Change in Reliance**: The majority of the teachers noticed that there was a strong shift in the way students behave and are deciding to move towards less and less reliance on their own efforts and move into more and more reliance on internet-based resources and the use of AI tools.
- **Promoting Styles:** The educators attested that there was a definite difference in the way the students develop the prompt. Students of scientific track concentrate on objective and technical questions, and the students of literary track are more devoted to stylistic and thematic descriptions.
- **Restricted Metacognition**: There was a split on the idea of whether AI leads to higher-order thinking. Though certain educators observed that there are some instances of improved comprehension of complicated lessons, most of them believed that AI can be a quick fix and not necessarily a metacognitive help.

2. **The "Cognitive Offloading" Risk and Educationalforaps**
- **Skill Erosion**: The educators came to an agreement that AI fosters dependence especially among the low-achievers. This brings in an unseen disparity of students being able to score high grades without a significant improvement in analysis skill.
- **Content Validation**: Several teachers were worried and tended to restrict the use of AI in the classroom so that students do not imbibe biased or inaccurate language information as a fact.

3. **Pedagogical Strategies and Academic Integrity**
- **Proactive Intervention**: To make sure that AI is a scaffold, but not a substitute, educators reported using the following strategies:
  - Designing tasks that require unique personal input and context-specific reasoning.
  - Prioritizing in-class activities and oral discussions to verify the authenticity of homework.
  - Strictly emphasizing the principles of academic integrity and the risks of plagiarism.

4. **Contextual and Institutional Barriers in Tripoli**
- **Infrastructure Deficits**: One of the themes was school under-resource. Although the teachers stated that they would like to train students in analytical thinking that is driven by AI, it is practically impossible to do this because of the lack of computer laboratories and even the internet in classrooms.
- **Curricular Constraints**: Educators complained about the volume of national curriculum and the shortness of teaching times, which provide no space to do critical and reflective practice related to healthy AI engagement.
- **Cultural Sensitivity**: EFL teachers pointed out that AI products sometimes contradict the Libyan cultural principles, and it is necessary to monitor the work of teachers constantly to make sure that the information corresponds to the values of the local culture.

Conclusion and Recommendations.

Conclusion

The research concludes that generative AI is a multi-layered intervention in the growth of analytical abilities in high school students in Tripoli, Libya. Although it has a huge prospect of augmenting analytical processes especially in the scientific tracks, it also poses a high risk of cognitive offloading especially amongst the students of the literary tracks. The key to successful integration is based on careful pedagogical planning, development of infrastructure, and curriculum development that takes into account local socio-technical and cultural factors.

Recommendations

On the basis of the results of this study, we suggest the following to improve the integration of GenAI in the Libyan secondary education:

1. **Ministry of Education and Decision Makers.**
- Infrastructure Development: stabilize school internet and outfit computer labs in high schools in Tripoli so that there is digital equity and inequality gaps are avoided.

- Curriculum Integration: Revise the national English curriculum to add AI Literacy, wherein prompt engineering and critical thinking take precedence over rote learning.
- Teacher Training: Provide educator training to re-train teachers as pedagogical intermediaries who will mediate through ethical AI use.

2. **Education: Teachers and School Administrations.**

- Personalized Strategies: In literary tracks, focus on narrative deconstruction in comparison with cognitive offloading; in scientific tracks, encourage AI to verify facts.
- Redesign of Assessment: Change to in-class assignments, verbal dialogues, and self-reflective assignments to maintain integrity.
- Metacognitive Scaffolding: Learn AI as a support (not a replacement) to thinking, particularly linguistic analysis.

3. **Students**

- Critical Agency: Check the result of AI against textbooks and Libyan cultural values.
- Constant Dynasty: Differentiate between learning and AI over-reliance to protect independent analytical abilities. This will mean that students will have to use AI as a means of further exploration instead of a replacement of independent thinking (Lyu et al., 2024).

Compliance with ethical standards
Disclosure of conflict of interest
The author(s) declare that they have no conflict of interest.

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