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Evaluation of Google Bard on Vietnamese High School Biology Examination

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Abstract: *This paper presents an evaluation of the performance of Google Bard on the biology test of the Vietnamese National High School Graduation Examination (VNHSGE). The study aims to assess the accuracy and effectiveness of Google Bard in solving biology problems commonly encountered in the Vietnamese curriculum. To facilitate the evaluation, the VNHSGE dataset was translated from Vietnamese to English, as Google Bard currently lacks support for the Vietnamese language. The findings reveal that* ***Google Bard*** *achieved a performance rate of* ***49.5%****, trailing behind competing models such as* ***ChatGPT*** *and* ***BingChat****, which achieved relatively higher scores of* ***58%*** *and* ***69%****, respectively. Notably, the translation process from Vietnamese to English might have impacted Bard's performance. Therefore, it is not recommended for Vietnamese students to solely depend on Google Bard for solving biology problems, especially if the Vietnamese language is not supported. Students should consider using language models explicitly designed for biology, such as* ***ChatGPT*** *or* ***BingChat****.*

Keywords: ChatGPT, Bing Chat, Bard, biology education, large language model.

I. Introduction

As artificial intelligence (AI) continues to advance, its application in education has gained significant attention. Google Bard, a language model developed by Google, has been proposed as a tool for assisting students in solving problems related to various subjects. This paper focuses on evaluating the performance of Google Bard in the context of the VNHSGE biology test. The primary objective is to determine whether Google Bard can accurately and effectively address the biology problems commonly encountered in the Vietnamese curriculum.

In their work, Thanh et al. [1] introduced an online learning platform featuring a Vietnamese Virtual Assistant, designed to aid educators in conducting lectures and evaluating students. In a separate study, Quy et al. [2] presented an approach involving AI-generated lecture materials. These materials take the form of slide presentations in PDF format, accompanied by synthesized speech and simulated facial expressions of the instructor, all derived from textual content.

Trang et al. [3] constructed a chatbot utilizing the Rasa framework and introduced an approach employing a tailored pipeline for the NLU model. Their approach incorporated pre-trained language models, namely FastText and BERT, while also implementing a customized tokenizer for the pipeline. The utilization of pre-trained language models in the NLU model demonstrated superior outcomes in comparison to training from scratch. In a separate study, Trang et al. [4] devised a Vietnamese chatbot centered around a

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seq2seq model bolstered by an attention mechanism. This model, created using a limited dataset, exhibited the capability to formulate responses for users. Nevertheless, further enhancements are required to refine the generated responses and attain more meaningful conversational interactions.

Hana et al. [5], [6], [7], [8], [9] embarked on a series of comprehensive investigations aimed at unraveling the multifaceted role of ChatGPT within the context of Vietnamese education. Through their meticulous studies, they discerned an array of potential advantages that ChatGPT could bestow upon administrators, educators, and students, fostering innovation and enrichment within the educational landscape.

Quy et al. [10], [11], [12] meticulously evaluated the performance of ChatGPT and Bing Chat in the context of the VNHSGE, encompassing a wide range of subjects, including mathematics [13], literature, English [14], physics [15], chemistry [16], biology, history, geography, and civic education [11]. The outcomes of their comprehensive investigations reveal a remarkable level of proficiency displayed by both ChatGPT and Bing Chat across the diverse spectrum of the VNHSGE Examination, attaining an average score ranging from 6 to 7 for both natural and social science combinations ([11], [12]). Notably, while Bing Chat excels over ChatGPT in the majority of subjects, it encounters stiff competition only in the realm of literature.

In [17], Quy et al. conducted an in-depth assessment of the performance of Large Language Models (LLMs) using the VNHSGE English dataset [10]. The results obtained from their investigation unveiled that Bing Chat exhibited the most impressive performance, achieving a notable score of 92.4%. Following closely, Bard garnered a commendable 86%, while ChatGPT secured 79.2%. This collection of outcomes strongly indicates that Bing Chat surpasses ChatGPT as a more efficacious language model specifically tailored to the demands of the VNHSGE dataset. The authors' contributions in this regard are of significant value, offering crucial insights into the capabilities of LLMs in the context of the VNHSGE dataset. These insights hold the potential to drive enhancements in the formulation and training of LLMs tailored for educational applications. It is imperative, however, to acknowledge the rigorous nature of the VNHSGE examination, where even the highest-performing language models exhibit imperfections. As such, further exploratory endeavors are warranted to advance the efficacy of LLMs in navigating the intricacies of the VNHSGE and similar challenging examinations

Google Bard, a substantial language model renowned for its versatility across diverse tasks, has garnered attention for its efficacy. Nevertheless, its competence in tackling the biology test within the framework of the VNHSGE examination remains relatively unexplored. This paper undertakes the task of meticulously appraising the proficiency of Google Bard when applied to the realm of Vietnamese biological education. The principal objective is to assess Google Bard's performance on the biology segment of the VNHSGE examination. To fulfill this goal, the paper delineates a comprehensive methodology specifically designed for evaluating Google Bard's efficacy within the context of the VNHSGE examination. The paper culminates with a comprehensive examination of the evaluation results, followed by an analysis of their implications, thus contributing insights into the potential utility of Google Bard in the domain of biology education.

II. Methods

To assess the effectiveness of Google Bard, the VNHSGE Vietnamese dataset [10] consisting of biology questions from the VNHSGE was selected. However, since Google Bard lacks support for the Vietnamese language, the dataset was translated into English to ensure compatibility. Google Bard was then employed to solve the translated biology questions. The performance of each model was measured based on its ability to provide correct answers.

A. Dataset

Within the confines of this paper, we leverage the VNHSGE dataset [10], a compilation curated from the Vietnamese National High School Graduation Examinations and analogous assessments. The focus of our scrutiny is directed towards the assessment of the VNHSGE biology dataset, encompassing a collection of 200 multiple-choice questions.

B. Prompt

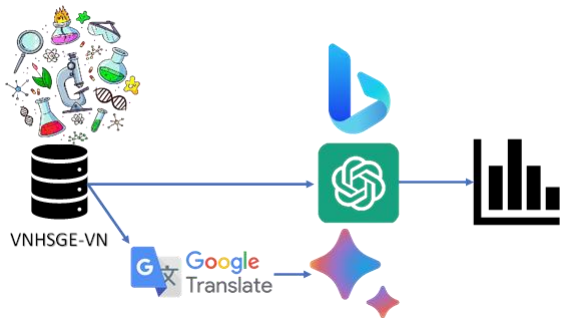

Figure 1. Prompt to Google Bard.

Figure 1 elucidates the sequential progression encompassing the interaction with Google Bard. Commencing the process, the VNHSGE dataset [10] originally in Vietnamese is subjected to translation into English utilizing the Google Translate API. Subsequently, the English-rendered questions from the VNHSGE dataset are presented as prompts to the Google Translate API[3]. As the final step, a Python package is harnessed to facilitate the retrieval of Google Bard's response, achieved through the value assigned to the cookie[4].

C. Grading

To assess the efficacy of Google Bard in furnishing answers, a meticulous assessment was carried out by juxtaposing its responses against the accurate solutions, commonly referred to as the ground truth. Employing a binary grading system, the evaluation procedure segregated Google Bard's answers into two distinct categories: correct and incorrect.

D. Limitations

This study has a notable limitation, which is the translation of the Vietnamese dataset to English. This process may have introduced inaccuracies in the questions and affected the models' performance. In future research, it would be valuable to evaluate Google Bard's performance with native Vietnamese language support. Additionally, the study could be extended to include more diverse datasets and subject areas to obtain a comprehensive understanding of the model's capabilities.

III. Results

A. Performance

Table 1 shows the performance of Google Bard, ChatGPT, and Bing Chat. The results of the evaluation revealed that Google Bard achieved a performance rate of 49.5% in solving the translated biology questions. This performance lagged behind both ChatGPT and BingChat, which achieved scores of 58% and 69%, respectively.

[3] Google Translate API for Python, googletrans 4.0.0rc1

[4] https://github.com/dsdanielpark/Bard-API

Table 1. Performance (%)

	ChatGPT [11]	**Bing Chat** [12]	**Bard**
2019	60	67.5	55
2020	60	72.5	45
2021	52.5	67.5	45
2022	57.5	72.5	47.5
2023	60	65	55
AVG	58	69	49.5

Figure 2 illustrates a comprehensive juxtaposition of the performance levels attained by ChatGPT, Bing Chat, and Bard throughout the VNHSGE Examination's biology test spanning the years 2019 to 2023. The outcomes manifest a discernible range in performance disparities, delineating a spectrum from 5% to 27.5%. This discrepancy fluctuates across the years, reaching its pinnacle at 27.5% in 2020, while registering its nadir at 5% in 2023.

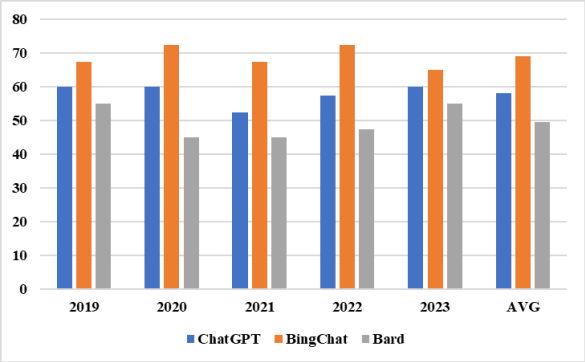

Figure 2. Performance comparison in years 2019-2023.

Figure 3 visually encapsulates the consistency exhibited by LLMs in their responses to the biology test within the VNHSGE examination. The data reveals that Google Bard displays a comparatively lower level of stability in its responses, contrasting with the more stable performance observed in ChatGPT and Bing Chat.

The observed instability and inferior performance of Google Bard in tackling biology problems could potentially stem from the translation procedure undertaken from Vietnamese to English. Nuances inherent to language and the intricacies of problem-solving approaches embedded within the Vietnamese curriculum might not have been faithfully conveyed during translation. As a consequence, Google Bard may have furnished erroneous or insufficient responses to certain queries.

To conduct a more in-depth exploration of Google Bard's performance, a direct evaluation using the original VNHSGE Vietnamese dataset becomes imperative. Such an approach would permit an unadulterated assessment of its performance, devoid of any confounding influences arising from the translation process.

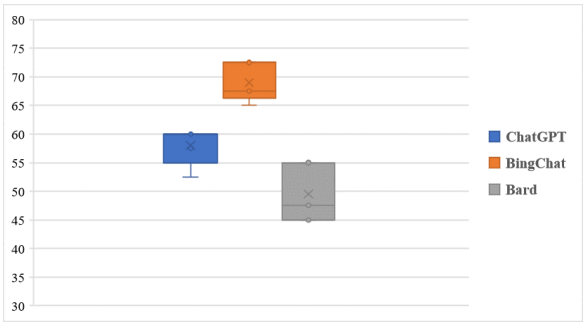

Figure 3. Stabilities of LLMs response.

B. Google Bard and Vietnamese students

Table 2 displays the scores of LLMs on the biology test of the VNHSGE examination, as well as the performance of Vietnamese students on the same test. The results show that Bard's score is similar to the Vietnamese students (AVS, MVS).

Table 2. Score

	ChatGPT [11]	**BingChat** [12]	**Bard**	**AVS**	**MVS**
2019	6	6.75	5.5	4.68	4.5
2020	6	7.25	4.5	5.6	5.25
2021	5.25	6.75	4.5	5.51	5.25
2022	5.75	7.25	4.75	5.05	4.5
2023	6	6.5	5.5	6.39	6.5

Figure 4 visually delineates the comparative evaluation of scores achieved by the three LLMs in contrast to the performance of Vietnamese students during the biology test within the VNHSGE Examination. The outcomes gleaned from the figure indicate that Bard attains an average score of 4.92, whereas ChatGPT and BingChat attain scores of 5.8 and 6.9, correspondingly. These observations lead to the inference that, in its present state, Bard might not be deemed an optimal tool for facilitating biology education among Vietnamese high school students, particularly when lacking support for the Vietnamese language. However, the outcomes underscore the potential of all three LLMs to serve as effective educational support tools within the domain of biology education in the Vietnamese context.

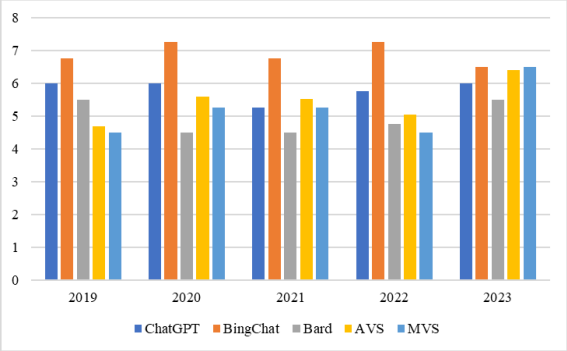

Figure 4. Score comparison of LLMs and Vietnamese students in years.

IV. Discussion

The comparative analysis of Google Bard's performance indicates that it might not be the most suitable tool for solving biology problems in the Vietnamese curriculum, especially when the Vietnamese language is not supported. In this section, we delve into the capabilities of Google Bard in supporting biology-related inquiries. Recognizing several compelling factors, we emphasize that the current juncture does not warrant Vietnamese students' complete reliance on Google Bard for their biology problem-solving endeavors. The following aspects underscore the rationale for this caution:

Language Limitations: Google Bard currently lacks support for the Vietnamese language. Consequently, Vietnamese students would be compelled to translate their biology queries into English prior to seeking assistance from Bard. This translation process introduces the potential for inaccuracies, impeding Bard's capacity to furnish precise responses.

Performance Disparity: In comparison to other LLMs, Bard's performance on the biology segment of the VNHSGE examination appears less robust. This divergence implies that Bard's effectiveness in resolving biology problems falls short when compared to its LLM counterparts.

Response Consistency: Bard's responses to biology queries demonstrate a lower degree of stability in contrast to other LLMs. This susceptibility increases the likelihood of Bard providing answers that are either incorrect or incomplete when tackling biology-related challenges.

Considering the cumulative evidence, it is currently advisable for Vietnamese students to exercise caution in exclusively relying on Google Bard for their biology problem-solving requirements. It is noteworthy, however, that Google Bard remains a work in progress, and there exists potential for enhancements in its performance over time. As Bard undergoes further development, the prospect of its improved efficacy in the realm of biology education remains a possibility.

V. Conclusion

In conclusion, this paper presents an evaluation of Google Bard's performance on the VNHSGE biology test. The results indicate that Google Bard achieved a performance rate of 49.5%, falling behind competing

models ChatGPT and BingChat. The study highlights the potential impact of translation on performance and suggests that students should consider using specialized subject-specific language models, such as ChatGPT or BingChat, for more accurate and effective problem-solving in biology. Further research is needed to explore the applicability of Google Bard when supported in native languages and across a broader range of subject areas.

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Appendix

Prompt/ Question	Answer	Grading
A paragraph of DNA molecules that brings encryption information for a polypeptide or a molecule called A. Protein. B. enzymes. C. Polid. D. gene.	The answer is **D. gene**. A gene is a segment of DNA that codes for a specific protein. The sequence of nucleotides in a gene determines the amino acid sequence of the protein. The amino acid sequence then determines the structure and function of the protein. A polypeptide is a long chain of amino acids. Proteins are made up of one or more polypeptides. Enzymes are proteins that catalyze chemical reactions. Polid is not a biological term. Therefore, the paragraph of DNA molecules that brings encryption information for a polypeptide or a molecule is called a gene.	Correct
In the human population, the gene specifies blood type A, B, AB and O there are 3 alleles are I^a, I^B, I^O.The allele frequency I^A is 0.3;The frequency of allele I^B is 0.5.Theoretically, the frequency of allele I^o is A. 0.2. B. 0.6. C. 0.4. D. 0.5.	The answer is **A. 0.2**. The sum of the allele frequencies of all three alleles must be 1, so the frequency of allele I^o is 1 - 0.3 - 0.5 = 0.2. Here's the math: * Allele frequency I^A = 0.3 * Allele frequency I^B = 0.5 * Allele frequency I^O = ? * Total allele frequency = 0.3 + 0.5 + I^O = 1 * I^O = 1 - 0.3 - 0.5 = 0.2 Therefore, the frequency of allele I^o is 0.2.	Correct
Which of the following statements about the competitive relationship between individuals in the biological population is wrong? A. The fierce competitive relationship, the individuals in the population become opposed. B. The individuals in the population compete for food, accommodation, lighting, ... C. Competition between individuals in the population only occurs in animal populations. D. Thanks to the competition, the number of individuals is maintained at an appropriate level.	The answer is C. Competition between individuals in the population can occur in both animal and plant populations. For example, plants compete for sunlight, water, and nutrients. Animals compete for food, mates, and territory. So the statement that competition between individuals in the population only occurs in animal populations is wrong. The other statements are all correct. Here is a brief explanation of each statement: * Statement A: The fierce competitive relationship, the individuals in the population become opposed. This statement is correct. When individuals compete for limited resources, they may become aggressive towards each other. This can lead to conflict and even violence. * Statement B: The individuals in the population compete for food, accommodation, lighting, ... This statement is also correct. Individuals in a population compete for all the resources they need to survive and reproduce. These resources can include food, water, shelter, mates, and territory. * Statement D: Thanks to the competition, the number of individuals is maintained at an appropriate level. This statement is also correct. Competition helps to regulate the size of a population. When the population becomes too large, the resources become scarce and competition increases. This can lead to some individuals dying or not reproducing, which helps to keep the population size in check.	Correct
indicates the coding of amino acids in the following table: Amino acid codon Lue 5’xuu3 ’;5’xux3 ’;	The correct answer is **B. 2**. Statement I is true because the third position of a codon is usually not significant. For example, the codons UUA, UUX, UUA, and	Correct

5’xua3 ’;5’xug3 ’ Trp 5’ugg3 ’ His 5’xau3 ’;5’xax3 ’ ARG 5’XGU3 ’;5’xgx3 ’; 5’xga3 ’;5’xgg3 ’ The encryption triplet is the trio that corresponds to the coding of amino acids and the triplet ends with the end of the Caoma ending on MARN.Suppose a genetic segment in synthetic bacteria mRIP has the beginning and sequence of nucleotides as follows: Mold Summary of mARN 3'TAXGAAAAXGXXGXTAGXAATT5 ' mARN 5'AUGXUUGGGXGGXAXGUUAA3 ' Knowing that each mutation replaces a pair of nucleotides on this gene that produces a new allele.In theory, how many of the following statements are true? I. Maximum of three coding triplets when any mutations replace any nucleotide pair in third place do not change the amino acid in the polypeptide. II.There is an encryption triplet when a mutation occurs in third place always changes the amino acid in the polypeptide chain. III.There are two coding triplets when the mutation occurs in third place, causing the occurrence of Caon to end early. IV.There is an encryption triplet when a mutant occurs in third place that leads to the appearance of the appearance of the MRNA created from this gene. A. 4. B. 2. C. 3. D. 1.	UUG all code for the amino acid leucine. Therefore, if a mutation occurs in the third position of any of these codons, the amino acid encoded by the codon will not change. Statement II is false because there are some cases where a mutation in the third position of a codon can change the amino acid encoded by the codon. For example, the codon UGG codes for the amino acid tryptophan, but if a mutation occurs in the third position to change UGG to UGA, the resulting codon will now code for the amino acid stop. Statement III is true because if a mutation occurs in the third position of a codon and causes the codon to become a stop codon, then the polypeptide chain will be terminated early. Statement IV is false because a mutation in the third position of a codon cannot change the start codon of a gene. The start codon is always AUG, and no mutation can change that. Therefore, the only two statements that are true are I and III. So the answer is 2.	
Which of the following is the following form, disease or syndrome? A. Syndrome. B. Hemorrhage is difficult to coagulate. C. Urinary dura disease. D. Excessive syndrome.	The answer must be a form of disease or syndrome. Of the above choices, only hemorrhage is difficult to coagulate is a form of disease. So the answer is (B).	Incorrect
Consider hybridization P: ♀ AABB x ♂ Aabb.Know in some cells during the body's gametes ♂, the chromosome pair contains a pair of AA genes that do not dissociate in fecal reduction, other processes that take place normally.Which of the following genotypes is not available at F1? A. AAABB. B. AAABB. C. AAABB. D. AAABB.	The answer is **D. AAABB**. The genotype AAABB is not possible because the Aa genes in the male gametes cannot be separated during meiosis. The only possible genotypes in the F1 generation are AaBb, Aabb, and aabb. Here is the Punnett square for the cross: ``` A a A	A	a B	AB	aB b	Ab	ab ``` The possible genotypes in the F1 generation are: * AaBb * Aabb * aabb The genotype AAABB is not possible because the Aa genes in the male gametes cannot be separated during meiosis. The Aa genes are linked, so they will always be inherited together. This means that the only possible genotypes in the F1 generation are those that contain the Aa genes linked together.	Incorrect
In mice, the hair color trait is specified by a gene with 4 alleles on regular chromosomes, the dominant alleles are	The correct answer is **B. 1**.	Incorrect

completely dominant.Give 6 P (denoted by A, B, C, D, E, F) of this species to perform the following hybrids: Hybrid 1 (P): ♂ Black hair (A) × ♀ Black fur (B) produces F_1 with 75% black fur: 25% brown fur. Hybrid 2 (P): ♂ Yellow hair (C) × ♀ White hair (D) produces F_1 with 100% yellow fur. Hybrid 3 (P): ♂ Brown hair (E) × ♀ Yellow Hair (F) produces F_1 with 25% white hair: 25% yellow fur: 50% brown fur. In theory, how many of the following statements are true? II.There are 2 genotypes that specify brown fur phenotypes. I. If based only on the phenotype ratio F_1 created from the above hybrids, determine the exact genotype of 4 of 6 P. III.Let the child (D) mate with the child (E) to create a child with a genotype ratio similar to the phenotypic ratio. IV.For the child (A) mating with the child (F), my life can have a rate of 50% of black fur: 50% of the yellow fur. A. 2. B. 1. C. 3. D. 4.	* Statement I is false. Based on the phenotype ratio of F1, we can only determine the genotype of 3 of the 6 P. * Statement II is true. There are 2 genotypes that specify brown fur phenotypes: BB and Bb. * Statement III is false. The genotype ratio of the offspring of D and E will be 1/2 DD:1/2 Dd:1/2 EE:1/4 dd. This is not similar to the phenotypic ratio of 25% white hair: 25% yellow fur: 50% brown fur. * Statement IV is true. The genotype ratio of the offspring of A and F will be 1/2 AA:1/2 Aa:1/2 FF:1/4 aa. This is similar to the phenotypic ratio of 50% black fur: 50% yellow fur. Therefore, only statement II is true. So the answer is **B. 1**.	
According to modern synthetic evolution theory, how many of the following statements are true? I. Mutations and random factors all provide primary mutations for evolution. II.The speed of forming the adaptive population in bacteria is slower than diploid species. III.Random elements and non -random mating both change the frequency of alleles and the genotype composition of the population. IV.Di - genetic and non -random mating can be poverty of the gene of a population. A. 2. B. 1. C. 3. D. 4.	The correct answer is **C**, 3. * Statement I is true. Mutations are the primary source of genetic variation in a population, and random factors can further increase this variation. * Statement II is false. Bacteria can evolve much more rapidly than diploid species, because they have a shorter generation time and can exchange genetic material more easily. * Statement III is true. Both random elements and non-random mating can change the frequency of alleles and the genotype composition of a population. * Statement IV is false. Di-genetic and non-random mating can actually increase the genetic diversity of a population. Therefore, there are 3 true statements out of the 4 given, so the correct answer is C.	Incorrect