Appendix to GPT-4 as a Homework Tutor can Improve Student Engagement and Learning Outcomes

October 2, 2024

1 Questionnaires

We report the initial questionnaire, the final questionnaire and the weekly questionnaire. We report the orginal questions in Italian as well as an English translation.

Table 1: Initial Questionnaire. Questions with negative sentiment are marked with a dagger(†)

Original Question	**Translation**	**Type of Answer**	**Dataset Label**
Età	Age		`age`
Sei mai stato rimandato in inglese?	Have you ever been held back in English?	Yes; No	`failed_english`
Come pensi che sia il tuo livello di inglese rispetto alla media della tua classe, al di là dei voti?	How do you think your level of English compares to the average in your class, aside from grades?	Below average; Slightly below average; Average; Slightly Above Average; Above Average	`english_level`
Qual'è la tua media in inglese quest'anno?	What is your average grade in English this year?	<6; 6-6.49; 6.5-6.99; 7-7.49; 7.5 - 7.99; 8 - 8.49; 8.5-9; >9; I would rather not disclose	`english_average`
General Questions: Questions marked with a '*' are standardized SESQ.			
Sono molto motivato/a a studiare per raggiungere buoni risultati a scuola.	I am very motivated to study to achieve good results at school.	6-point Likert	`motivated_to_study`
Mi impegno molto per avere buoni risultati in inglese.	I work hard to get good results in English.	6-point Likert	`effort_in_english`
Faccio fatica a stare al passo col programma di inglese	I struggle to keep up with the English program	6-point Likert	`struggled_with_english`†
Voglio raggiungere un buon livello di inglese nei prossimi anni	I want to achieve a good level of English in the coming years	6-point Likert	`goal_c1_english`
Penso di avere le capacità per raggiungere un buon livello di inglese nel corso dei prossimi anni	I think I have the capacity to reach a good level of English in the coming years	6-point Likert	`confidence_in_ability`
Avrei bisogno di più supporto e risorse per riuscire a raggiungere un buon livello di inglese	I would need more support and resources to achieve a good level of English	6-point Likert	`need_more_support`

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Table 1 – *Continued from previous page*

Question	Translation (English)	Type of Answer	Label
* In inglese, indipendentemente da quanto un argomento è difficile, sono sicuro di poterlo capire.	In English, no matter how difficult a topic is, I am sure I can understand it.	6-point Likert	`confident_in_english`
* Non sono sicuro di poter imparare gli argomenti più difficili del programma di inglese.	I am not sure I can learn the most difficult topics of the English program.	6-point Likert	`doubt_difficult_topics`†
* Sono sicuro di poter andare bene in verifiche, interrogazioni e/o test di inglese.	I am sure I can do well in quizzes, oral exams, and/or English tests.	6-point Likert	`confident_in_tests`
* Per quanto mi sforzi, non riesco a imparare l'inglese	No matter how hard I try, I cannot learn English	6-point Likert	`cant_learn_english`†
* Quando un esercizio è troppo difficile, lo salto oppure faccio solo le parti più facili.	When an exercise is too difficult, I skip it or just do the easier parts.	6-point Likert	`skip_hard_exercises`†
* Quando un argomento è troppo difficile, lo salto e non provo a impararlo.	When a topic is too difficult, I skip it and do not try to learn it.	6-point Likert	`skip_hard_topics`†
Sono portato per le lingue.	I am talented for languages.	6-point Likert	`good_at_languages`
ARCS - Homework			
I compiti di inglese sono noiosi.	English homework is boring.	6-point Likert	`homework_boring`†
I compiti di inglese sono utili per migliorare il mio livello di inglese.	English homework is useful for improving my level of English.	6-point Likert	`homework_improves_english`
I compiti di inglese sono utili per ottenere conoscenze che mi serviranno in futuro.	English homework is useful for gaining knowledge that will be useful in the future.	6-point Likert	`homework_future_knowledge`
Ho le capacità personali per portare a termine correttamente i compiti di inglese tutte le volte.	I have the personal abilities to properly complete English homework every time.	6-point Likert	`ability_finish_homework`
Avrei bisogno di più supporto e risorse per riuscire a fare i compiti di inglese.	I would need more support and resources to be able to do English homework.	6-point Likert	`need_support_homework`†
Sono soddisfatto di quello che imparo facendo i compiti di inglese.	I am satisfied with what I learn from doing English homework.	6-point Likert	`satisfied_with_homework`
ARCS - Lectures and Contents			
I contenuti del programma di inglese non mi interessano.	The contents of the English program do not interest me.	6-point Likert	`uninterested_in_content`†
Le lezioni di inglese sono utili a migliorare il mio livello di inglese.	English lessons are useful in improving my level of English.	6-point Likert	`lessons_improved_english`
Le lezioni di inglese mi forniscono conoscenze utili per il mio futuro.	English lessons provide me with useful knowledge for my future.	6-point Likert	`lessons_future_knowledge`
Ho le capacità personali per stare al passo col programma di inglese.	I have the personal abilities to keep up with the English program.	6-point Likert	`ability_keep_up`

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Table 1 – *Continued from previous page*

Question	Translation (English)	Type of Answer	Label
Avrei bisogno di più supporto e risorse per riuscire a stare al passo col programma di inglese.	I would need more support and resources to be able to keep up with the English program.	6-point Likert	`need_support_to_keep_up`†
Complessivamente, sono soddisfatto di quello che imparo a scuola in inglese.	Overall, I am satisfied with what I learn in English at school.	6-point Likert	`overall_satisfaction`

Table 2: Final Questionnaire

Original Question	Translation	Type of Answer	Dataset Label
Da quale dispositivo hai eseguito l'accesso alla piattaforma per i compiti per casa?	From which device did you access the platform for homework?	Mobile, Laptop, Both	`device_used`
General Questions: Questions marked with a '*' are standardized SESQ.			
Nelle ultime 8 settimane, ho fatto fatica a stare al passo col programma di inglese	In the last 8 weeks, I have struggled to keep up with the English program	6-point Likert	`struggled_with_english`†
Voglio raggiungere un buon livello di inglese nei prossimi anni (approssimativamente un C1)	I want to reach a good level of English in the coming years (approximately a C1)	6-point Likert	`goal_c1_english`
Penso di avere le capacità per raggiungere un buon livello di inglese (approssimativamente un C1) nel corso dei prossimi anni	I think I have the ability to reach a good level of English (approximately a C1) over the coming years	6-point Likert	`confidence_in_ability`
* In inglese, indipendentemente da quanto un argomento è difficile, sono sicuro di poterlo capire	In English, no matter how difficult a topic is, I am confident I can understand it	6-point Likert	`confident_in_english`
* Non sono sicuro di poter imparare gli argomenti più difficili del programma di inglese	I am not sure I can learn the more difficult topics of the English program	6-point Likert	`doubt_difficult_topics`†
* Sono sicuro di poter andare bene in verifiche, interrogazioni e/o test di inglese	I am confident that I can do well in quizzes, oral exams, and/or English tests	6-point Likert	`confident_in_tests`
* Per quanto mi sforzi, non riesco a imparare l'inglese	No matter how hard I try, I cannot learn English	6-point Likert	`cant_learn_english`†
* Quando un esercizio è troppo difficile, lo salto oppure faccio solo le parti più facili	When an exercise is too difficult, I skip it or only do the easier parts	6-point Likert	`skip_hard_exercises`†
* Quando un argomento è troppo difficile, lo salto e non provo a impararlo	When a topic is too difficult, I skip it and do not try to learn it	6-point Likert	`skip_hard_topics`†
Sono portato per le lingue	I am talented at languages	6-point Likert	`good_at_languages`
ARCS Homework			
Nelle ultime 8 settimane, i compiti di inglese sono stati noiosi	In the last 8 weeks, the English homework has been boring	6-point Likert	`homework_boring`†

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Table 2 – *Continued from previous page*

Question (Italian)	**Question (English Translation)**	**Type of Answer**	**Label**
Nelle ultime 8 settimane, i compiti di inglese sono stati utili per migliorare il mio livello di inglese	In the last 8 weeks, the English homework has been useful for improving my level of English	6-point Likert	`homework_improves_english`
Nelle ultime 8 settimane, i compiti di inglese sono utili per ottenere conoscenze che mi serviranno in futuro	In the last 8 weeks, the English homework has been useful for gaining knowledge that will be useful in the future	6-point Likert	`homework_future_knowledge`
Nelle ultime 8 settimane, ho sentito di avere le capacità personali per portare a termine correttamente i compiti di inglese tutte le volte	In the last 8 weeks, I have felt that I personally had the abilities to properly complete the English homework every time	6-point Likert	`ability_finish_homework`
Nelle ultime 8 settimane, avrei avuto bisogno di più supporto e risorse per fare i compiti di inglese	In the last 8 weeks, I would have needed more support and resources to do the English homework	6-point Likert	`need_support_homework`†
Sono soddisfatto di quello che ho imparato facendo i compiti di inglese nelle ultime 8 settimane	I am satisfied with what I have learned from doing the English homework in the last 8 weeks	6-point Likert	`satisfied_with_homework`
ARCS Lectures and Contents			
Nelle ultime 8 settimane, i contenuti del programma di inglese non mi interessavano	In the last 8 weeks, the contents of the English program did not interest me	6-point Likert	`uninterested_in_content`†
Nelle ultime 8 settimane, le lezioni di inglese sono state utili a migliorare il mio livello di inglese	In the last 8 weeks, the English lessons have been useful in improving my level of English	6-point Likert	`lessons_improved_english`
Nelle ultime 8 settimane, le lezioni di inglese mi hanno fornito conoscenze utili per il mio futuro	In the last 8 weeks, the English lessons have provided me with useful knowledge for my future	6-point Likert	`lessons_future_knowledge`
Nelle ultime 8 settimane, ho sentito di avere le capacità personali per stare al passo col programma di inglese	In the last 8 weeks, I have felt that I personally had the abilities to keep up with the English program	6-point Likert	`ability_keep_up`
Nelle ultime 8 settimane, avrei avuto bisogno di più supporto e risorse per riuscire a stare al passo col programma di inglese	In the last 8 weeks, I would have needed more support and resources to keep up with the English program	6-point Likert	`need_support_to_keep_up`†
Complessivamente, sono soddisfatto di quello che ho imparato in inglese a scuola	Overall, I am satisfied with what I have learned in English at school	6-point Likert	`overall_satisfaction`
Questions for Treatment Group Only			
Trovi che il tutor ti sia stato d'aiuto nello svolgere i compiti per casa?	Did you find the tutor helpful in doing homework?	Yes; No; No Access	`tutor_helped_homework`
Trovi che il tutor ti abbia aiutato a migliorare l'inglese ad un livello pratico?	Did you find that the tutor helped you improve English to a practical level?	Yes; No; No Access	`tutor_improved_english`

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Table 2 – *Continued from previous page*

Question (Italian)	**Question (English Translation)**	**Type of Answer**	**Label**
Trovi che avere accesso al tutor ti abbia aiutato a stare al passo col programma di inglese?	Did having access to the tutor help you keep up with the English program?	Yes; No; No Access	`tutor_helped_keep_up`
Vorresti continuare ad avere accesso al tutor in futuro?	Would you like to continue having access to the tutor in the future?	Yes, for all exercises; Yes, for some exercises; No; No access	`continue_with_tutor`
Quali aspetti del tutor hai trovato utili?	Which aspects of the tutor did you find useful?	Options: Personalized explanations; Feedbacks and Corrections on My Answers; Guidance through the Exercise Step by Step	`useful_tutor_aspects`
Spesso, il tutor mandava messaggi troppo lunghi anche quando non era necessario	Often, the tutor sent messages that were too long even when not necessary	6-point Likert	`tutor_long_messages`
Spesso, il tutor diceva cose non vere oppure mi diceva che sbagliavo anche quando la mia risposta era corretta	Often, the tutor said things that were not true or told me I was wrong even when my answer was correct	6-point Likert	`tutor_wrong_feedback`
Final Comments			
Hai qualche altro commento sull'esperienza in generale?	Do you have any other comments on the general experience?	Free text response	`general_comments`

Table 3: Weekly Questionnaire

Question	**Translation (English)**	**Type of Answer**	**Label**
Week-level Questions			
Hai fatto, o provato a fare, almeno uno degli esercizi assegnati questa settimana? (rispondi sinceramente, non condivideremo la risposta con la tua insegnante)	Have you done, or tried to do, at least one of the exercises assigned this week? (answer honestly, we will not share the response with your teacher)	Yes; No	`completion`
I compiti per casa di questa settimana erano interessanti e/o stimolanti (rispetto ai compiti per casa prima dell'esperimento).	This week's homework was interesting and/or stimulating (compared to homework before the experiment).	6-point Likert	
I compiti per casa di questa settimana sono stati utili a migliorare il mio inglese ad un livello pratico.	This week's homework has been useful in improving my English to a practical level.	6-point Likert	
Exercise-Specific Questions - These questions are repeated for each exercise.			
Questo esercizio è stato utile a migliorare la mia comprensione e la mia conoscenza dell'argomento trattato.	This exercise was useful in improving my understanding and knowledge of the topic covered.	6-point Likert	

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Table 3 – *Continued from previous page*

Question	Translation (English)	Type of Answer	Label
Avevo a disposizione supporto e risorse a sufficienza per risolvere adeguatamente questo esercizio (spiegazioni, materiali, ...)	I had enough support and resources available to adequately solve this exercise (explanations, materials, ...).	6-point Likert	
(**Treatment-Group Only**) Quali aspetti hai trovato utili? (seleziona tutte le opzioni rilevanti)	(**Treatment-Group Only**) Which aspects did you find useful? (select all relevant options)	Options: Personalized explanations; Feedbacks and Corrections on My Answers; Guidance through the Exercise Step by Step	`useful_aspects_1`
Anomalies Feedback			
Il sistema ha avuto dei comportamenti anomali? (se sì, puoi descriverli brevemente?)	Did the system exhibit any abnormal behaviors? (if yes, can you briefly describe them?)	Open-ended	`anomalies`

1.1 Regression Tables

Variable	Coefficient	Std. Error
Intercept	3.5828	0.743
Treatment	-0.4456	1.027
3rd Year	4.0815	0.852
Words Typed	0.001	0.001

Table 4: OLS Regression Results: Learning Gains Mediated by Student Engagement

2 Prompts

2.1 Tutoring Prompt

The following prompt was the main prompt given to the tutor as the system prompt. We replaced assignment purpose, description and example with the content provided from the teacher. Note that the Common European Framework of Reference for Languages was mistakenly referred to as "Cambridge Framework" during the execution of the study.

```
We are helping students learn english as a second language.

We give you an exercise as a starting point.  Act as a tutor and drive the student through the same concepts, testing
the understanding step by step.  It is not necessary to replicate to the example exercise, as long as you cover the same
concepts.  Follow the tutoring strategy we provide.

Start with a brief explanation of the concept.
Provide at least 10 questions, one by one.
Do not move on until the student gives the correct answer.
If necessary, provide explanations and feedback.
Never give the answer to the question.
Do not give the answer to the question as a part of the explanation.
Point out all grammar and spelling mistakes.
Keep a B2 level of English according to the Cambridge framework.

Once all questions are solved, ask the student if they wish to practice more.  If they don't, output <COMPLETE>
```

```
EXERCISE PURPOSE:
+++ purpose +++

EXERCISE DESCRIPTION
+++ description +++

EXERCISE EXAMPLE (NOT VISIBLE TO THE STUDENT)
+++ example +++

TUTORING STRATEGY
+++ strategy +++
```

2.2 Strategy Generation Prompt

The following prompt was used to generate the tutoring strategy.

```
We are helping students learn english as a second language.

We give you an exercise as a starting point.
Provide a concise, step-by-step strategy for a short dialog-based tutoring session led by ChatGPT with a student covering
the same concepts.
The tutoring session is text-based and led through a chat interface.
Describe the strategy with a maximum of six sentences.

Keep a B2 level of english according to the Cambridge framework.
+++ assignment.purpose +++
+++ assignment.description +++
+++ assignment.example +++
```

3 Homework Content

We report the content of homework for each class and each week.

	3rd Year	5th Year
Unit 0	-	**(Only class 5A) WWI, open questions**: Students answer questions about WWI and British responses in 8-10 lines.
Unit 1	**Conditionals, sentence correction**: Students are asked to fix mistakes in the given sentences. **Conditionals, sentence completion**: Students complete sentences using the correct tense of the verb in brackets. **Conditionals, sentence transformation**: Students complete the second sentence to have the same meaning as the first using the given word.	**Poem commentary, analysis, and comparison**: Students analyze and compare "The Soldier" by R. Brooke and "Dulce et Decorum est" by W. Owen.
Unit 2	**I wish/If only and mixed conditionals, either/or questions**: Students choose the correct verb form from two options for sentences using "I wish," "If only," and mixed conditionals. **I wish/If only and mixed conditionals, sentence completion**: Students complete sentences using the correct tense of the verb in brackets.	**Key events of the 20th century, open questions**: Students answer questions about 1967, WWII, and Margaret Thatcher in 4-6 lines.

Unit 3	**Essay on contemporary social issues**: Students write a 200-220 word argumentative essay on a contemporary social issue.	**The Roaring 20s, open questions**: Students answer questions about the economic, political, and social changes in the US during the 20s, including "The Great Gatsby."
Unit 4	**Passive voice, sentence transformation**: Students transform active sentences to passive form while keeping the same tense. **Passive voice, sentence completion**: Students complete sentences using the correct tense of the verb in brackets, focusing on passive forms. **Passive vs. active voice, either/or questions**: Students choose the correct active or passive form and tense from two options given.	**Mid-century America, open questions**: Students answer questions about the Cold War, the 60s, cultural revolution, and the crisis of the 70s in the US.
Unit 5	**Causative verbs (have/get something done), sentence completion**: Students complete sentences using the correct tense of the verb in brackets, focusing on the causative form. **Passive voice with double object, sentence transformation**: Students transform active sentences with two objects to passive form, giving both options.	**Human rights movements, Gandhi, open questions**: Students answer questions about Gandhi's life, achievements, and influence in 4-6 lines.
Unit 6	**Reported speech statements, sentence transformation**: Students transform direct statements into reported speech, using the correct tense based on the introductory verb. **Reported speech questions, sentence transformation**: Students transform direct questions into reported speech, using the correct tense based on the introductory verb. **Reported speech correction, sentence correction**: Students correct the mistakes in sentences related to reported speech using different reporting verbs.	**(Only class 5B) Important women in history, open questions**: Students answer questions about Queen Victoria, Emmeline Pankhurst, and Rosa Parks in 4-6 lines.