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Minds VS Machines: A Comparative Study of AI and Teacher-Generated Summaries in English Language Teaching

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Abstract

This study investigates the differences between human-generated and AI-generated summaries in a remote English as a Foreign Language (EFL) lesson setting, addressing the research problem of how each approach captures and interprets lesson content. Utilizing Zoom-AI as the AI summarization tool, the study compares its output with summaries created by ten human educators. Each participant summarized the same lesson, providing a basis for direct comparison. The methodology involved qualitative analysis, focusing on aspects such as content comprehensiveness, pedagogical judgment, contextual understanding, and the recognition of classroom dynamics. The key findings have revealed that while the AI-generated summary is significantly more efficient in capturing the content, it lacks depth in educational insights and contextual nuances. Conversely, human-generated summaries appear to have provided richer educational judgments and a better understanding of classroom interactions but sometimes deviated from the core content, decreasing their educational value. The study suggests a complementary approach, integrating AI's efficiency with human expertise through a human-in-the-loop system to enhance the overall quality and utility of educational summaries. These results have important implications for integrating of AI in educational settings, highlighting the potential for AI to assist educators and the irreplaceable need for the nuanced understanding and contextual interpretation that human educators provide.

Keywords: Artificial Intelligence (AI), Artificial Intelligence in Education (AIED), discourse analysis, English as a Foreign Language (EFL), teacher education, teacher-student interaction, remote teaching, Zoom

Data Availability Statement: *All relevant data are within this paper.*

Introduction

The dynamics of teacher-student interaction and the interpretation of lesson content play a pivotal role in shaping the learning experience. Artificial Intelligence (AI), defined as the simulation of human intelligence by machines capable of learning, reasoning, and problem-solving (Morandín-Ahuerma, 2022), has introduced transformative possibilities to education. In English Language Teaching (ELT), AI has reshaped how lessons are planned, delivered, and evaluated, with tools such as chatbots, adaptive learning systems, and automated feedback mechanisms enhancing instructional practices (Luckin et al., 2022; Molenaar, 2022).

Beyond these technological applications, AI also holds promise for advancing our understanding of classroom discourse and teacher-student interactions. This study focuses on the potential of AI to interpret lesson content by comparing AI-generated and human-generated summaries in ELT settings. The exploration of AI in this context extends beyond technological assessment to examine its pedagogical implications, particularly in a field where language nuances, cultural references, and content depth are crucial.

Despite the growing integration of AI tools in education (Bilad et al., 2023), a notable gap in the literature persists regarding the qualitative differences between AI- and human-generated lesson summaries. This study addresses that gap and seeks to show the potential implications of these differences for classroom practice, teacher development, and even AI's role in education. Specifically, it attempts to answer the following questions:

1. *How does the AI-generated lesson summary compare to human-generated summaries in an ELT lesson?*
2. *What are the strengths and limitations of AI in generating summaries that can be used for educational purposes in ELT?*

Literature Review

Recent advancements in AI have significantly influenced learning and teaching. Although it is perceived as a new hype phenomenon, AI has been used for the past 50 years in a variety of ways. Carbonell (1970), for instance, created an *adaptive* geography instruction system, which he named SCHOLAR. Also, the International AIED Society was founded in 1993 (Molenaar, 2022). Even if it is for research purposes, AI has been around for many years, and its potential benefits have been investigated in many ways (Luckin et al., 2022); yet, the use of AI has never been experienced with such enthusiasm by millions of students and educators as it has been in recent memory. One possible explanation is that its role has not yet been firmly delineated by experts or widely experienced by the general public, unlike in the finance, banking, and healthcare sectors.

In many everyday scenarios—such as when calling a bank—individuals often engage solely with AI systems, effectively replacing human employees. Although the early vision of AI in Education (AIED) mirrored this notion of a complete replacement, the more recent goal has shifted toward an Augmentation Perspective (Molenaar, 2022). This perspective views both teachers and students as learners participating in human learning. In this case, AIED has the potential to enhance learning and teaching by facilitating both processes.

AI language learning tools, utilizing algorithms like Machine Learning (ML) and Natural Language Processing (NLP), offer personalized learning experiences and introduce learners to diverse cultures

(Rebolledo Font de la Vall & Araya, 2023). These tools have evolved to integrate technologies such as Virtual Reality (VR) and Augmented Reality (AR), enhancing the language learning process. Furthermore, AI's role in language learning extends beyond traditional methods, facilitating error identification, feedback provision, and language ability assessment (Woo & Choi, 2021). On the other hand, while AI tools offer opportunities for language learning, they also pose challenges, such as hallucinations in AI-generated content, raising concerns about accuracy. Privacy issues and ethical dilemmas also arise from extensive data collection, while overreliance on AI risks diminishing critical thinking and creativity, emphasizing the need for cautious integration (Ivanov, 2023).

Moreover, the digital divide (Egbert & Yang, 2004), referring to the gap between those with and without access to digital technology, can limit the effectiveness and reach of AI in language learning, especially in under-resourced areas. This disparity may introduce a new AI divide that educators and students must also deal with (Rajagopal & Vedamanickam, 2019).

Discourse Analysis and the Use of AI

As the study aims to compare the text quality produced by AI against text produced by humans, Discourse Analysis (DA) is likely to be the most viable analysis technique. DA is widely recognized as one of the most prevalent qualitative analysis techniques, offering insights by interpreting spoken or written communication within its broader context (Zajda, 2020). Context, in this sense, encompasses not only the physical setting of the interaction but also the social and cultural norms, values, and expectations that influence it. These contextual factors shape participants' anticipations regarding the flow of interaction and the roles each participant assumes within it.

On the other hand, in a classroom setting, teachers typically pose questions, and students respond, reflecting a distinct power and social dynamic. For instance, students traditionally must seek the teacher's permission to contribute to the discussion. Sinclair and Coulthard (1975) showed that teacher-student interaction forms a pattern that they referred to as Initiation-Response-Feedback (IRF). Their seminal work ignited a series of studies analyzing interaction in different contexts (e.g., courtroom interaction and doctor-patient interaction). Various researchers have investigated teacher-student interaction (Can-Daşkın, 2015), highlighting its importance in understanding teachers' choices as objectively as possible (Nicholson, 2014). Within the framework of DA, classroom interaction is no longer characterized as truncated or viewed as an inadequate representation of authentic language. Researchers analyzed classroom discourse as a real interaction in its own right.

Despite the constraints imposed by students' limited language proficiency, a significant amount of information is nonetheless conveyed during classroom lessons. In essence, DA is employed to examine how language is used in context. By doing so, researchers uncover the ways in which language expresses diverse viewpoints, ultimately revealing how individuals perceive and articulate their experiences of events and places. This focus on the interpretive function of language is what makes DA a distinctive research approach. Hence, DA aims to go beyond the literal meaning of chunks of language because human communication enables humans to process the intricacies of daily interaction. Children aged 6-7 develop an understanding and skills to deduce the underlying meaning and to read between the lines (Lee, 2022). One may wonder whether AI can interpret observed events and synthesize summaries from a valid perspective. However, such an expectation might be overly ambitious at the moment, as AI lacks the depth of subjective experience and intrinsic understanding that humans naturally bring to interpretive processes.

However, there have been attempts to use the skills of AI to facilitate the teaching of writing (Qijing, 2021) and even analyze intercultural conversation (Salama et al., 2022). Qijing (2021) emphasizes

Multimodal discourse analysis (MDA), which examines how different communication modes—like language, images, gestures, and symbols—combine to create meaning, and its integration in English Language Teaching significantly enhances students' writing skills by fostering the use and interpretation of various semiotic resources. For example, teaching students how images complement text can deepen their understanding and improve their expressive abilities, aligning with the demands of digital-age communication that requires proficiency across multiple modes. Research, such as that by Wanselin et al. (2022), underscores the effectiveness of MDA, showing how tools from social semiotics and systemic functional linguistics can reveal how multimodal texts convey meaning, thereby informing instructional strategies that enrich writing. Similarly, Salama et al. (2022) explore conversation analysis, which can be instrumental in understanding the nuances of communication, especially for Arab-English foreign language learners. Moreover, Kovalchuk et al. (2022) examine the use of speech verbs in media discourse, demonstrating how DA can inform students about language patterns and styles in written communication in multiple contexts. Finally, and perhaps more importantly, DA is a vital tool in examining the different instructional approaches and teachers' practices inside the classroom and for later reflection (Keles, 2019). Using DA as a reflective tool allows teachers to delve into the complexities of classroom interactions, leading to improved educational quality. Teachers can uncover hidden dynamics that affect student participation and engagement by examining aspects such as turn-taking and contextual cues. For example, analyzing turn-taking patterns helps identify which students may feel marginalized, prompting strategies to encourage equitable participation. Attention to non-verbal cues, such as body language, enhances teachers' understanding of students' responses, fostering a more inclusive classroom environment. Additionally, exploring framing in classroom discourse enables teachers to adapt their communication to be more culturally responsive, creating a collaborative space where diverse perspectives are valued. This reflection helps shift classrooms from traditional, one-way instruction to interactive, student-centered learning, where students feel empowered to participate, fostering critical thinking and a richer learning experience. Integrating AI tools for summarization in education might offer new opportunities for teacher training, students' notes, and administrative purposes.

Nevertheless, discourse-based use of AI is not limited to teaching language skills. AI can also assist human employees in managing extensive text corpora. Automated summary generation, a technique that has been explored for some time, has also been tested in the field of discourse summarization (Bosma, 2008). The advent of AI-driven text summarization techniques, as discussed by Zhang et al. (2022), has introduced new methods for creating coherent and contextually relevant summaries. AI-based summarization tools and techniques are now ubiquitous social media discourse (*Introducing Periodic Summary Reports Using AI on Discourse!,* 2024). These techniques not only aid in processing large texts but also facilitate the process of writing summaries for all purposes of a particular text type.

Recent studies have explored the characteristics of AI-generated text, focusing on aspects like coherence, style, and accuracy. Ma et al. (2023) investigated the gap between AI-generated and human-written scientific text. They found that while AI can generate accurate content, there are still gaps related to depth and overall quality, particularly in language redundancy and factual issues. In a similar vein, Gunser et al. (2022) examined the stylistic qualities of AI-generated literary texts and found that they were perceived as less well-written and less inspiring than human-written texts. For instance, in their research, Ma et al. (2023) highlight the subtleties that AI-generated text misses compared to human writing, such as coherence, depth, factual accuracy, and logical structure. That is, while human authors create cohesive arguments, staying on-topic and ensuring smooth transitions between related ideas, AI-generated content can feel disjointed, as when an AI discussing "quantum computing in cryptography" might digress unexpectedly into "healthcare diagnostics" without relevance or context. In terms of depth, human writers provide layered reasoning, such as discussing how emission reduction requires both technological advancements and policy changes. At the same time, AI might oversimplify,

only stating that "reducing carbon emissions will slow global warming." Additionally, AI frequently introduces factual inaccuracies, such as referencing non-existent studies (e.g., (*Smith et al., 2018)* on marine species and plastic pollution) instead of verified sources, which can erode trust. AI also lacks the pragmatic precision necessary for complex arguments, leading to contradictions, such as initially labeling "hydrogen as a renewable energy source" and later describing it as "produced from fossil fuels." These limitations highlight the challenges of relying on AI-generated content for the nuanced, accurate, and logically consistent discourse required in scientific writing. Similarly, Simonsen (2022) also reported that users found AI text generators easy to use but were not impressed with the quality of AI-generated content, indicating the need for several editing operations. This finding can be a reason for carrying out more studies where the performance of humans and AI are compared and contrasted.

While the exploration of AI-generated text and summaries has been a subject of interest in recent studies, there remains a notable gap in the literature regarding the comparison of AI-generated summaries from platforms such as italki (italki, n.d.) and Zoom (Zoom Team, 2023) with those produced by humans. These platforms have recently introduced AI capabilities for summarizing content, yet there is a lack of comprehensive analysis on how these AI-generated summaries compare against human-generated ones. This gap is significant as it leaves unanswered questions about the efficacy and utility of AI in practical applications like online language learning. Understanding the strengths and limitations of AI-generated summaries in these contexts is crucial, as it can inform educators, professionals, and technology developers about AI's potential roles and impacts in enhancing communication and learning experiences. Therefore, research focusing on this comparison is essential to evaluate the effectiveness of AI in capturing the essence of spoken or written content in educational and professional settings and to determine how it can be optimally utilized or improved.

Methods

Research Design

This qualitative study employs DA to examine and compare lesson summaries produced by the participating teachers and the Zoom-AI companion, a tool designed for automated content summarization of virtual meetings. A qualitative approach is well-suited for this study because it allows for an in-depth exploration of the interpretive and contextual nuances present in human-generated summaries, which cannot be fully captured through quantitative methods (Creswell & Creswell, 2018).

The Zoom-AI companion was chosen as the AI tool for this study because, at the time of the research, it was the only publicly accessible tool capable of *watching* virtual lessons via a videoconferencing program and providing automated summaries. To date, no other publicly available tool offers this capability although this may change in the future as AI technologies continue to evolve.

Discourse Analysis enables the study to examine how language is used to represent lesson content, uncovering patterns and themes that reveal the interpretive processes of both humans and AI (Urooj & Ahmad, 2020). Furthermore, the research questions—centered on the features, quality, and depth of these summaries—emphasize the need for an interpretive approach rather than numerical or statistical analysis.

Participants

The participants in this study consist of 10 Turkish EFL teachers (6 females and 4 males), all of whom hold at least a bachelor's degree in English Language Teaching or Literature. The selection of participants was dictated by convenience sampling since these are the individuals the researchers had

access to. They also represent a range of demographic variables. These variables include differences in age, years of experience, and educational qualifications. Detailed demographic information for the participants is presented in Table 1.

Table 1 *Participants' Demographic Information*

Participant	Gender	Age	Highest Degree Attained	Additional Teaching Qualifications	Years of Experience	Time to Complete the Task
Participant 1	Female	35	BA	CELTA	11 Years	60 Minutes
Participant 2	Female	22	BA	None	2 Months	120 Minutes
Participant 3	Male	29	MA	MA in ELT	8 Years	30 Minutes
Participant 4	Female	30	BA	CELTA	8 Years	95 Minutes
Participant 5	Female	25	BA	None	3.5 Years	90 Minutes
Participant 6	Male	29	PhD	None	6 Years	NA
Participant 7	Female	26	BA	None	4 Years	80 Minutes
Participant 8	Male	28	BA	TEFL/TESOL	3 Years	120 Minutes
Participant 9	Male	22	BA	None	1 Year	120 Minutes
Participant 10	Female	28	BA	None	6 years	120 Minutes

Note. All the names have been anonymized for privacy reasons. Moreover, the teacher (Jack) and the student (Paul) in the video will be given pseudonyms for the same reasons. Participant 6 was not able to provide a time since he did not time himself.

Materials

The materials for this study included a video recording of a one-to-one EFL teaching session conducted over Zoom. The session spanned 59 minutes and featured a B2-level student engaged in a speaking lesson with a qualified EFL teacher (one of the researchers). The lesson primarily focused on teaching and practicing speaking skills and incorporating vocabulary related to technology and general feedback on grammatical mistakes and pronunciation. Both the human teachers and the Zoom-AI companion were asked to summarize the session. The context of the lesson centers on an individual who is color blind and has created an antenna implanted in his head. This invention allows him to perceive colors by capturing color wave frequencies and interpreting them in his brain, ultimately leading him to identify as a *Cyborg*. It is important to note that this lesson is designed to be taught over the course of three sessions, with the session in this video recording representing the first one. The complete lesson plan and materials are available in the Appendix.

Data Collection and Procedures

A Google form that contained the informed consent and items to elicit demographic information and the video recording was created. Then, the direct link to the form was sent to the selected participants via email or WhatsApp. The prompt provided to the participants was specific and purposeful:

> Please watch this recorded lesson and provide a summary of it. The summary should be around 700 - 800 words. This is a summary, not an evaluation or commentary on the quality of the lesson and the performance of the participants. The purpose is to summarize what happened during the class.

This prompt was deliberately crafted to elicit summaries focused solely on the content and events of the lesson without inviting subjective assessments or reflections on teaching quality.

To preserve the integrity of the study and to avoid any potential bias, no additional information or guidance was provided to the participants beyond the initial prompt, even when asked. This approach was taken to ensure that the summaries reflected the participants' interpretations and cognitive processing of the lesson content.

Once the participants had completed their summaries, their responses were submitted through the same Google form. The form automatically collated the summaries, consent confirmations, and demographic details into an Excel sheet which the researchers later downloaded.

Data Analysis

The data analysis for this study was conducted on a corpus comprising summaries from the teachers and the Zoom-AI companion, totaling 7,547 words. The analysis was carried out using MAXQDA, a specialized software tool for qualitative discourse analysis, which offers a robust and versatile platform for handling textual data. MAXQDA was chosen for efficiently organizing and managing large volumes of qualitative data and to enable the researchers to systematically code, categorize, and analyze the corpus (Kuckartz & Rädiker, 2021). Additionally, its advanced visualization tools, such as word frequency analysis and code matrix tables, provided deeper insights into patterns and themes within the data. The software's user-friendly interface and flexibility in integrating various qualitative analysis techniques further ensured a comprehensive and precise examination of the textual summaries, making it an ideal choice for this study.

Inductive coding was used throughout the analysis phase (Thomas, 2006). This method allowed for the emergence of patterns and categories directly from the data rather than imposing preconceived categories or theoretical perspectives. Inductive coding was applied to both the participants' summaries and the Zoom-AI summary, ensuring a consistent and unbiased approach to data analysis across all sources. By relying on the data itself to guide the coding process, inductive coding reduces the risk of researcher bias that may arise from predetermined frameworks or assumptions (Stuart, 2024). This approach fosters objectivity, as it does not prioritize specific theories or hypotheses but instead allows themes and insights to emerge naturally from the data. Also, inductive coding may reveal themes that researchers had not previously anticipated. Thomas (2006) emphasized that inductive coding is particularly effective for condensing complex and unstructured raw text data into manageable and meaningful categories, helping to establish clear links between the research objectives and the findings. This focus on data-driven analysis ensures that it remains grounded in the participants' and AI's actual outputs, rather than being influenced by external theoretical expectations.

The Coding Process

The researchers began by thoroughly familiarizing themselves with the data by repeatedly reading the summaries while simultaneously viewing the video recordings of the lesson. This approach allowed the researchers to gain a deeper understanding of the content and context.

Moreover, the analysis employed thematic analysis (Thomas, 2006) based on the main concept of each coded segment, focusing on elements relevant to the research questions such as the similarities and differences between the AI summary and the participants. Descriptive labels were assigned to data segments that appeared significant, ensuring that the coding process was inductive and grounded directly in the data

rather than being guided by pre-existing frameworks. This initial phase resulted in 340 coded segments distributed across 75 codes.

Following the initial coding, similar codes were grouped into broader categories by either creating new codes or merging existing ones. For example, the codes "Muscovite," "Prototype," and "Restoration vs Renovation" were integrated into a broader category labeled "Introduction of New Lexical Items." This refinement process reduced the number of codes to 14 main codes, each encompassing multiple sub-codes or categories.

Subsequently, the 14 main codes were carefully reviewed to identify common concepts and synthesize overarching themes. For instance, codes related to the language and structural elements of the summaries were grouped under the umbrella theme of "Linguistic and Structural Aspects." This process resulted in five overarching themes that encapsulated and represented the refined codes. To ensure the themes were firmly grounded in the data, representative quotes were selected to illustrate each theme, authentically capturing participants' experiences and perspectives. The five main themes that emerged from this analysis are:

1. **Educational Items**: This theme encompassed elements of the summaries that directly related to educational content. It included references to key concepts such as target vocabulary, pedagogical strategies such as analyzing words' morphemes, and specific instructional content mentioned in the ELT lesson. This theme was crucial for assessing the educational value and relevance of the summaries, and it covered 12.2% (921 words) of the whole corpus.
2. **Content Inclusion and Representation**: This theme focused on how comprehensively and accurately the summaries captured the content of the ELT lesson. It involved examining the extent to which important information was included or omitted in the summaries, how accurate the content is, and how well the summaries represented the core ideas and themes of the lesson. This theme covered 42.4% (3,200 words) of the corpus.
3. **Linguistic and Structural Aspects**: This theme dealt with the language use and structural organization of the summaries. This was particularly important for understanding the clarity, readability, and linguistic appropriateness of the summaries, especially in the context of ELT where language use is paramount. This theme accounted for 10.7% (807 words) of the corpus.
4. **Educational Insights**: This theme captured the deeper, more interpretive aspects of the summaries. It included insights into instructional procedures, teachers' opinions and justifications for various classroom events during the lesson, and pedagogical implications suggested by the summaries. This theme was instrumental in understanding the potential of the summaries to provide meaningful educational insights to teachers and students, especially since it spanned over 31.6% (2,385 words) of the corpus.
5. **Additional Notes**: This theme/category included codes representing observations that did not logically belong to any of the other themes but were deemed important enough to be coded and explored because of their relevance. This theme/category accounted for 1.98% (150 words) of the corpus.

Results

In this section, the results of the thematic analysis are presented. Also, excerpts from summaries are presented without editing the text for the reader. The themes follow the structure shown in Table 2.

Table 2 *Themes and Sub-themes Emerged from the Data Analysis*

Theme	Sub-theme	Category
Educational Items	Vocabulary Exercise Mention	
	Technique for Understanding Morphemes	
	Introduction of New Lexical Items	
Content Inclusion and Representation	Inclusion of Lesson Structure and Main Topic	
	Comprehensiveness of AI-Generated Summary	
	Omission of Key Lesson Content	
Linguistic and Structural Aspects	Use of Jargon	
	Language Accuracy	
	Metaphorical vs. Literal Language	
	Inclusion of Lesson Recap	
Educational Insights	Objectivity of AI	
	Educational Insights from Teachers	Educational Procedure
		Educational Justification and Reasoning
		Specific Educational Technique
	Feedback and Correction	
Additional Notes	Misunderstandings in Summaries	
	Lack of Meta-Awareness in AI	

Educational Items

The analysis of the summaries from the speaking lesson focused primarily on educational items, particularly vocabulary, as this was the central element of the lesson. The findings in this category revealed several key points:

Vocabulary Exercise Mention

The results reveal that 9 out of 10 of the teachers and the AI included references to a vocabulary exercise in their summaries. This exercise constituted a significant part of the lesson, and its inclusion highlights its perceived importance by both human participants and the AI. Notably, the participants' explanations appear more comprehensive than the AI summary. For example, the Zoom-AI summary states, "Towards the end, they went through a list of highlighted words and their meanings, with Paul attempting to match them." In contrast, Participant 4 provided a more detailed account, "After completing the task, the student is asked to match the word definitions with the words. The student matches the definitions, and the teacher observes the student to ensure that he understands the meanings in detail." Similarly, Participant 9 elaborated further:

> *Then*, the teacher shows a picture of the vocabulary activity. *First*, the teacher asks the student to read the sentences aloud. *While* the student reads the sentences, the teacher

> checks the pronunciation. *After* that, the teacher gives the instructions for the matching activity and asks the student to complete it.

While the AI summary is more concise, the participants' narratives demonstrate superior readability and provide richer contextual details. Moreover, the use of transitions in the participants' excerpts enhances coherence and cohesion, making their descriptions more accessible and logically structured. These differences underscore the added value of human summarization in capturing the nuance and flow of classroom activities.

Technique for Understanding Morphemes

Nearly all teachers (8 out of 10) and the AI referenced the teaching technique introduced in the lesson for breaking down words into morphemes as a strategy to infer their meanings. This technique is considered essential for vocabulary acquisition, and its widespread mention reflects its perceived educational value within the lesson. Both the participants and the AI acknowledged its significance in fostering vocabulary learning. However, there were notable differences in the way this strategy was described and appreciated across the summaries. For example, the Zoom-AI summary highlights the strategic value of the technique including, the excerpt: "Jack emphasized the importance of breaking down new words to understand their meanings and connections to other words. This can help in learning and remembering new vocabulary."

Similarly, many participants recognized this approach as a valuable learning strategy. However, some participants, specifically Participants 2 and 6, mentioned the technique in a more casual manner without explicitly identifying its strategic or educational importance. For instance, Participant 2 stated, "He gave other versions of that word as an example. After, the teacher talked about the words' origins and the suffixes and affixes it has. The teacher gave other examples for the student to guess the meaning." Also, Participant 6 noted, "They focused on the word *implant*. The teacher explained the formation of prefixes in this word and similar words."

Unlike the AI and other participants, Participants 2 and 6 did not use any evaluating expressions that could have explicitly indicated the pedagogical significance of this technique as a strategy for vocabulary learning. This contrast underscores the variability in how participants perceived and articulated the educational value of the teaching approach. The AI summary, by comparison, consistently emphasized the broader utility and purpose of the strategy, offering a more structured and explicit appreciation of its role in the lesson.

Introduction of New Lexical Items

The lesson involved the introduction of new lexical items, but it was observed that both the participants and the AI rarely mentioned these items by name in their summaries. This suggests a general tendency to refer to the lexical content indirectly rather than explicitly identifying specific vocabulary terms. For instance, when the teacher introduced the word *Muscovite*, Participant 3 wrote, ". . . Then they think about a demonym that is used in English to denote a person's association with a particular city or locality." Similarly, the AI and other participants often provided generalized descriptions. For example, the Zoom-AI summary noted, "They discussed the meanings of certain words and phrases, with Paul [the student] providing his understanding of them." Likewise, Participant 2 reported, "He gave other versions of that word as an example. After, the teacher talked about the words' origins and the suffixes and affixes it has. The teacher gave other examples for the student to guess the meaning."

On the other hand, when the lesson involved corrective feedback or clarification, there was a higher likelihood of these elements being explicitly noted in the summaries. For example, the teacher's discussion about the political correctness of the terms *blind* versus *visually impaired* was included by six participants and also noted by the AI. Participant 6 wrote, "The teacher then encourages the student to use the phrase *visually impaired* instead of *blind* to teach politically correct expressions."

However, not all participants were explicit in such cases. Participant 10 simply stated, "At one point, the teacher gave additional information on a word that the student used. He showed the student a more politer way to say it" without any further explanation or mention of the word itself. Similarly, the distinction between restoration and renovation was explicitly mentioned by only three human participants though it was also captured by the AI.

Apart from these instances involving corrective feedback or clarifications, specific vocabulary terms were generally not named in the summaries. These findings from the category of Educational Items reveal patterns in how both human participants and the AI processed and prioritized different aspects of the lesson content, suggesting a preference for general descriptions over the explicit identification of individual lexical items.

Content Inclusion and Representation

The analysis of content inclusion and representation in the summaries revealed distinct patterns in how the AI and human educators captured the lesson's content:

Inclusion of Lesson Structure and Main Topic

Both human educators and the AI consistently included elements related to the lesson's structure, such as assigning homework and exchanging greetings, in their summaries. For example, the AI noted, "Jack then assigned Paul some homework related to this topic" and "Paul should watch the video and answer the questions sent by Jack." Similarly, Participant 4 stated, "As homework is assigned to the student to get more information about the person in the picture and his gadget." Perhaps, most comprehensively, Participant 3 provided a detailed description:

> The teacher says that he has sent the student an assignment via Telegram application. There is a file, and in this file, there is a two-minute YouTube video. The student is expected to answer questions about the video. Finally, the teacher and the student thank each other and say goodbye.

It is clear that the previous excerpts had details a student could use to understand their assigned tasks. However, all the other human-generated summaries omitted certain information about homework. For example, Participant 5 did not mention it at all, and many human participants provided only general descriptions. Participant 1 wrote, "At the end, homework was assigned and explained." Participant 7 similarly stated, "Then the teacher gives homework and clarifies it with details and ends the lesson." Offering a vague account of what the homework is.

The main topic of the lesson, which centered on cyborgs, was also mentioned in all summaries. For instance, Participant 6 included, "Then he asked if he thought there was a cyborg today and asked the student to explain." Similarly, Participant 2 wrote, "They furthered the discussion by talking about what scares them about being cyborgs in the future, and the student stated that he thinks that is part of evolution."

Additionally, it was observed that only the AI and Participant 9 structured their summaries using headings and subheadings, adding a layer of organization that was absent in the summaries of the other participants. This further demonstrates the AI's systematic approach to content structuring, which differed from the more narrative style used by most human participants.

Comprehensiveness of AI-Generated Summary

The summary generated by the AI was unique in its ability to capture all the main ideas and details of the lesson. Specific items such as "Virtual Reality Eyes," "Visiting places at night," and "Neuralink" were exclusively mentioned by the AI. Additionally, certain references—such as the "Robocop" example—were largely overlooked by human educators. Only Participant 2: ". . . The student gave the example of RoboCop and they talked about the movie for a while. . ." and the AI: "They also talked about the movie Robocop and Jack mentioned a project called the Cyber Dine Initiative, which is related to cybernetics," included this reference in their summaries.

Omission of Key Lesson Content

A significant portion of the core content of the lesson was overlooked in most human-generated summaries, whereas the AI consistently included key details. For instance, the AI summarized the discussion on the disadvantages of Bluetooth, stating, "Jack explaining that color blindness is a condition where a person cannot recognize colors or sees them differently." Additionally, the AI captured a critical point posed by the teacher regarding the usefulness of the antenna: "Jack pointed out that such functions could already be done with NFC tags and questioned the usefulness of the antenna." The AI also mentioned the second function of the antenna, an aspect that many human participants failed to include in their summaries. This pattern of omission was repeatedly observed across various elements of the lesson content.

Even when human participants mentioned specific topics, their summaries were often less effective or incomplete. This distinction was particularly evident in the discussion of definitions. For example, while Participants 4 and 2 referred to the discussion on color blindness, only Zoom-AI provided the actual definition in its summary. The AI noted: "Jack explained that color blindness is a condition where a person cannot recognize colors or sees them differently." In comparison, Participant 4 wrote, "After mentioning the disabled part, the teacher says that the person in the picture is colorblind and he needs this gadget for the identification of the colors by using the frequency of the colors." Participant 2 added: "After that, they talked about color blindness and if the student knew anyone who is colorblind."

These excerpts highlight that while human participants briefly acknowledged the topic, their descriptions lacked the clarity and specificity provided by the AI. The AI's comprehensive and detailed representation of the lesson content suggests its potential utility in ensuring that critical aspects of the lesson are not overlooked. By consistently capturing a broader range of lesson elements, the AI demonstrates an ability to generate summaries that are both more detailed and inclusive than those created by human participants.

Linguistic and Structural Aspects

The analysis of linguistic and structural aspects of the summaries revealed significant differences between the AI-generated and human-generated content:

Use of Jargon

Human educators frequently employed jargon in their summaries, assuming the reader would have educational expertise. In contrast, the AI-generated summaries primarily utilized simpler, everyday

language. This difference in language choice has implications for the accessibility of the summaries, particularly for audiences without a specialized educational background, such as students or administrators. For example, Participant 2 wrote: "There was a *negotiation of meaning* between the teacher and the student." Similarly, Participant 3 noted: "Then they think about a *demonym* that is used in English to denote a person's association." Participant 8 added: "Following this, in order to increase the involvement and activate the background *schema* of a student." Such statements might indicate that teachers can interpret the data by using their experience and deduce the teacher's intentions, but this also might render their summaries inaccessible to the general audience.

In contrast, the AI summaries avoided specialized terminology, opting for more straightforward expressions that could be more easily understood by a general audience. This contrast highlights a tendency among human participants to prioritize precision and theoretical language, which, while accurate, may limit the summaries' broader accessibility. Conversely, the AI's use of everyday language enhances its potential to communicate effectively across diverse reader groups.

Language Accuracy

The AI-generated summaries were free of linguistic errors, demonstrating a high level of grammatical and lexical precision. In contrast, human teachers collectively made 27 language errors across their summaries. Notably, no human-generated summary was entirely free of mistakes. While some errors, such as the omission of articles (e.g., *the*), did not significantly impede comprehension, a more pressing concern was the instances of ambiguity found in the human-generated summaries. Specifically, three instances of ambiguity were identified in the summaries from Participants 2, 3, and 6, as illustrated below:

> Participant 2: "After he read it, teacher gave him some important recommendations about structures. He gave him some vocabulary and definitions."
> Participant 3: "At this stage, the similarity of the words 'extension' and 'continuation' is mentioned. The teacher asks if it is something scary, the student responds that it is a stage of evolution."
> Participant 6: "They started the conversation by asking what he did on the weekend."

These examples highlight instances where the intended meaning may be unclear, potentially leading to misunderstandings or misinterpretations of the lesson content. The AI's ability to consistently avoid such ambiguities reinforces its reliability in producing clear and comprehensible summaries. Conversely, the errors and ambiguities in the human-generated summaries suggest the need for more careful language use and editing to ensure clarity and precision.

Metaphorical vs. Literal Language

The AI-generated summaries were characterized by direct and literal language, with no instances of metaphorical or figurative expressions. In contrast, human participants used metaphorical language on five different occasions, reflecting a more creative or descriptive approach to summarizing the lesson content. For example, Participant 1 noted: "Then he *fed* the topic with more questions to make him speak." Similarly, Participant 6 used figurative expressions in two instances: "They also *touched upon* the working systems of museums.""". . . he *touched upon* a very important issue about disabled people." Participant 8 also employed metaphorical language, writing: "More importantly, as he *opens the gate* for speaking opportunity…" and "The feedback was not provided immediately, teacher leaves him *space* where he…".

This stylistic difference underscores the AI's preference for straightforward and literal expression, which may enhance clarity and reduce the potential for misinterpretation. In contrast, human educators

occasionally opted for more creative language to convey ideas, as seen in phrases like "*fed the topic"* or "*opens the gate for speaking opportunity."* While these figurative expressions add richness and depth to the summaries, they may also introduce a level of abstraction that could complicate comprehension for some audiences.

Inclusion of Lesson Recap

A common structural element in almost all summaries, both AI and human-generated (6 out of 10), was the inclusion of a recap of the current lesson or at least a reference to the previous one. For example, Participant 4 mentioned, "The lesson mostly focuses on gadgets that have some functions for disabled people and also the related vocabulary to this topic." Also, Participant 9 mentioned, "Then, the teacher asks about the topic they talked last week and homework." However, the AI summary was more detailed:

> Jack and Paul discussed potential places to visit, with a focus on museums. They talked about their preference for historical museums and the importance of understanding the difference between restoration and renovation. They also touched upon cyborgs, technological installations, video games, color perception, frequency, and antennas. The conversation later shifted to the advancement of technology, AI, and cybernetic enhancements. They also discussed the cost of dental care in different countries and the concept of cybernetic enhancements. Towards the end, they assigned some homework related to the topic of cybernetic enhancements.

This consistency across summaries shows the recognized importance of linking current lesson content to that of the previous one, a key aspect in educational discourse to reinforce learning continuity.

The findings of this theme illustrate the distinct linguistic and structural approaches between AI and human educators in summarizing ELT content. The AI's adherence to more straightforward language and error-free writing contrasts with the human educators' use of jargon and occasional linguistic inaccuracies. In addition, the absence of metaphorical language in AI summaries compared to its presence in human summaries points to a fundamental difference in stylistic choices.

Educational Insights

The analysis of educational insights within the summaries revealed the biggest distinct differences between AI and teachers. This offers a window to the cognitive processes and the insights the humans' unique backgrounds can offer.

Objectivity of AI

The AI-generated summary was marked by its objectivity, characterized by a strictly factual and report-like style. Unlike human participants, the AI refrained from making assumptions, offering interpretations, or providing justifications for events occurring within the lesson. This approach ensured a consistent focus on observable details, but it lacked the depth of subjective interpretation often found in human-generated summaries.

For example, in the greeting sections of the summaries, participants highlighted their interpretations and judgments of the interactions, weaving personal perspectives into their observations. Participant 5 described the start of the lesson: "The lesson started with a customary greeting, followed by small talk." In the same vein, Participant 3 noted their perception of the atmosphere: "Jack gives a positive vibe, Paul seems to have a neutral mood but he seems to be content."

Other participants elaborated on the conversational tone and approach. Participant 6, for example, observed, "They started the lesson with a nice and sincere conversation. They started the conversation by asking what he did on the weekend." Similarly, Participant 7 emphasized the teacher's engagement, stating: "The teacher gives appropriate and lively reactions to his student's responses."

Words such as *vibe, sincere,* and *lively* reflect subjective judgments based on the participants' interpretations of the interactions, highlighting a level of engagement that includes reading between the lines of the observed behavior. In contrast, the AI avoided such evaluative language, focusing solely on the factual sequence of events without delving into perceived emotional or interpersonal dynamics.

Unlike humans, AI seems to take things at their face value. This stark difference illustrates the AI's inability to interpret or infer beyond the presented information, ensuring objectivity but potentially overlooking nuanced human elements in the lesson. While this objectivity can enhance consistency and reliability, it may lack the richness and depth provided by subjective human insights. Sometimes, human insights are based on their experience and enable them to guess other people's intentions.

Educational Insights from Teachers

In contrast to the AI summary, the human educators' summaries were enriched with invaluable insights drawn from their educational backgrounds. Teachers often included educational justifications for actions carried out in the class, insights into the educational procedures being implemented, and the types of support provided to students. Table 3 shows example excerpts of each category of this sub-theme.

Table 3 *Different Categories of the Educational Insights from Teachers Sub-theme*

Category	Participant	Example Excerpt
Educational Procedure	Participant 1	The following activity was a question to be answered by the student to have a talk about the connection between an antenna and the disability of the man in the visual.
	Participant 2	Teacher gave directions for him to use the online board's marker.
	Participant 4	The teacher guides the student to brainstorm in every stage of the lesson.
Educational Justification and Reasoning	Participant 8	…thus leading the way to integrate him into the lesson.
	Participant 5	While talking about the gadget, the teacher gives some ideas to the student to make more comments on the picture to make real-life connections.
	Participant 10	The teacher asked questions; he wanted the student to make connections between his background knowledge and the new topic.
Specific Educational Technique	Participant 1	The teacher asked if the student knew anyone who had the same problem as the man in the picture.
	Participant 2	The teacher asked questions as to make him elaborate on that subject.
	Participant 2	While student was answering the question, teacher used recasts.
	Participant 5	…employing strategic scaffolding…
	Participant 5	Jack reinforced Paul's understanding, especially when the latter related points.
	Participant 3	He tries to make the meaning of the word felt by using the scaffolding method.

These insights offer a deeper understanding of the pedagogical context and rationale behind classroom activities which the AI did not/could not provide in its summary. These evaluative comments from teachers add a layer of critical analysis and personal perspective to the summaries, enhancing their educational value.

Feedback and Correction

Feedback and correction are crucial components of the educational process (Klimova, 2015); thus, they are also crucial in an educational report or summary. Out of 27 instances of corrective feedback identified during the lesson, only one was noted by the AI—"Jack also corrected Paul's pronunciation and grammar in a few instances"—whereas human educators recorded the remaining cases. Moreover, the AI did not specify any pronunciation-related feedback, in contrast to human teachers. For example, Participant 6 observed, "Meanwhile, again, they focused on the pronunciation of the word 'of.' The teacher said that the word was pronounced with a v sound," and Participant 7 highlighted grammatical feedback: "The student gives his answer with the wrong subject pronoun and the teacher corrects him with the accurate pronoun." However, aside from the two participants mentioned above, the remaining participants generally followed the previous pattern of noting that a correction took place without specifying its exact nature. For instance, Participant 4 wrote, "By letting the student read the sentences, the teacher focuses on the student's pronunciation to check and correct some of the mistakes that the student makes," exemplifying this tendency.

This underscores the AI's limitation in identifying and reporting corrective feedback within an educational context. At the same time, the lack of specificity in human-generated summaries suggests a missed opportunity to fully utilize the educational value of these corrections, which could be attributed to human fallibility, such as being distracted, tired, or bored—limitations that do not affect AI, as it is never subject to fatigue or loss of focus.

In addition to the primary themes analyzed, there were two observations in the summaries that did not belong to any other category per se but were still noteworthy:

Misunderstandings in Summaries

Instances of misunderstandings about the lesson content were evident in the summaries of Participant 3 and Participant 4, highlighting inaccuracies in how the events or discussions were interpreted. Participant 3, for example, wrote, "The person in the photo has an antenna on the head and underneath the photo, there are related words and synonyms." This interpretation was incorrect; while the teacher and student discussed words associated with the photo, no words or synonyms were, in fact, present beneath the image. It seems Participant 3, mistakenly, inferred their physical presence.

Similarly, Participant 4 had a misinterpretation, stating, "He mentions that the antenna and one of the teeth are connected." This inaccurately represented the discussion. In reality, the Cyborg in the lesson, who does have an antenna on his head, spoke about a future plan to develop a Bluetooth tooth and connect it to the antenna. Participant 4 appears to have interpreted this future aspiration as a current reality.

These examples highlight the potential for human summaries to include misinterpretations or inaccuracies, emphasizing the need for careful attention to detail and clarification during the summarization process. Such misunderstandings can lead to conveying incorrect information, which may affect the overall utility and accuracy of the summaries.

Lack of Meta-Awareness in AI

A notable distinction between AI-generated and human-generated summaries was the absence of meta-awareness in the AI's output. While human educators frequently demonstrated an understanding of their role and the roles of the people they are watching within the lesson context, acknowledging elements such as the remote nature of the session and the use of digital tools like Google Docs, the AI did not include any such references, revealing an absence of meta-awareness.

This human meta-awareness appeared in eight instances across the summaries. Participant 1, for example, wrote, "They have a doc that they both can work" highlighting the collaborative use of a shared Google Docs document. Participant 3 reflected on the lesson's structure, noting, "An assignment is mentioned, it seems that the student has been given a task and is expected to report on it," showing the ability to infer information that they do not currently have. Other participants provided similar observations. Participant 4 remarked, "The teacher tells the story of Neil (the character in the picture)," showing that they can *see* the content visually. Participant 7 also added, "The teacher screen shares a worksheet and asks the student to read aloud the sentences."

These examples highlight the ability of human participants to situate their summaries within the broader context of the lesson, referencing tools, interactions, and processes that framed the teaching session. In contrast, the AI-generated summaries lacked this contextual layer, focusing strictly on the content of the lesson without recognizing or reflecting on the lesson's delivery or the tools used to facilitate it.

This absence of meta-awareness in the AI summaries underscores a limitation in its ability to capture the full scope of the teaching environment, including the lesson content and the dynamics and tools that shape the learning experience. In comparison, human-generated summaries provided a richer narrative that encompassed both content and context.

Discussion

The first major theme to be tackled is how effectively these summaries captured the essence of the lesson. It is evident from the findings that AI-generated summaries tend to excel in this aspect, consistently offering a more comprehensive and lexically dense narration of what happened during the lesson without compromising on the number of ideas, examples, and details that came across in the lesson, as confirmed by previous studies (Alrumiah & Al-Shargabi, 2022). At first glance, this might seem to be advantageous, but summaries, by their very definition, require a discerning approach to content selection, emphasizing elements of high importance while omitting those of lesser relevance (Ke & Hoey, 2014). For example, the AI wrote, "Jack and Paul discussed possible places to visit when it gets dark," which is a trivial line that does not offer any educational value. Most of the human participants omitted this line, presumably exercising their pedagogical discretion and chose to omit this detail, deeming it irrelevant since teachers' notion of relevance is driven by educational context, curriculum, and school policy (Diekema & Olsen, 2012). Thus, describing the AI-generated content as comprehensive may be misleading, given that the AI lacks the capacity to judge or evaluate which elements are most valuable to include. Instead, it adopts a scattershot approach, incorporating all information in a condensed and concise manner. It could be argued that this defeats the purpose of a summary as in its nature, a summary requires the author to be selective as aforementioned. Moreover, the variability in AI-generated summaries, as highlighted by Goodman et al. (2024) in clinical applications (e.g., discharge notes), underscores the probabilistic nature of Large Language Models (LLMs), which often results in inconsistent and overly comprehensive outputs (e.g., listing trivial

details). This aligns with findings in this study, where AI summaries lacked pedagogical discretion, including trivial content which human participants deemed irrelevant.

However, it should be noted that, at least in the experiment at hand, the teachers' summaries lacked focus regarding the content. The more experienced teachers, such as Participant 8, delved so deeply into analyzing the rationale behind each action that they neglected the lesson content. In fact, he alone accounted for 38.4% of the educational judgments across all the 10 participants. This indeed might be beneficial if the goal of the summary was to be shown to pre-service teachers since it is common practice for teachers to study and observe lessons of more experienced teachers (Langsford, 2024) or examined in a teachers' professional development program such as the ones relying on Lesson Study (Sims & Walsh, 2009), but the prompt of the task explicitly stated that this is to be a summary and not an evaluation. In addition, even if used as training materials, the actual content must be present for the trainees to reflect on the educational commentary. In fact, every single human participant included such judgments though that goes against the initial prompt.

Nevertheless, this shows that teachers are capable of interpreting the behavior of the individuals during the lesson, especially with more experienced teachers (Graham et al., 1993), while the AI was only able to mention the behavior. Moreover, if this were to be used as an automated summary for learners hoping to help improve the learners' educational outcome similar to NoteSum (Wang et al., 2020) which effectively summarizes notes, improving readability, informativeness, and completeness for learners, this would also be of limited usefulness. This is because these educational judgments might not be of use to non-experts, especially when it is filled with jargon and, more importantly, the vast majority of the important happenings in the lesson, such as correction, feedback, introduction of lexical items, and so forth, are referenced but without mentioning the item itself. In other words, if a student reads Participant 2's statement, ". . .The student talked about a word but the teacher corrected him . . ." or Participant 9's statement, ". . . While the student describes the picture, the teacher continues to provide some keywords. . ." he or she would be unable to identify the specific new concept or correction to be learned. This phenomenon seems to be the two extremes of objectivity and subjectivity in this experiment. While the AI refrained from making judgments—or perhaps was incapable of doing so—educators tended to overcompensate by relying heavily on their own backgrounds and cognitive frameworks to guide their interpretations. While this approach can be beneficial at times (Borg, 2003), it requires more direction and a systematic approach to be truly effective.

There is, however, a solution to this. Zoom-AI can be trained on specific datasets that have valuable insights and use machine learning (El Naqa & Murphy, 2015) in order to contextualize such live sessions as lessons eventually. This has been previously proposed by Luckin and Çukurova (2019), not for Zoom-AI specifically, but for any AI model engaging in educational practices. Other LLMs, such as ChatGPT-o1, the newest installment from Open AI, might be able to extrapolate such judgments because of their advanced reasoning algorithm in many fields such as health (Temsah et al., 2024) and math (De Winter et al., 2024); but it currently does not have the capability of *monitoring* a virtual lesson over a videoconferencing software. LLMs such as Khamingo (Khan Academy, 2023), which is an LLM specifically trained to take on the persona of a tutor and offer educational insights, already exist. Training Zoom-AI on similarly targeted datasets could potentially mitigate the issue discussed above. Moreover, software developers can use studies such as the current one to *fine-tune* their language models to have a specific style and rules of what is important and what is not (Chhabra et al., 2019).

Another key difference is the awareness of the participants compared to the non-awareness of the AI. LLMs, such as ChatGPT, Bard, and Zoom-AI, are trained on datasets that are mainly composed of large amounts of text, and we are only at the starting stage of multimodality, which is an AI that was trained on datasets of different modalities, i.e., photos, texts, audio, and so forth though it is claimed

that this will be the norm soon (Lee et al., 2023). This means that essentially Zoom-AI, the tool that was used here, is *deaf*. What it does is *read* the transcript of the meeting that is done by another algorithm, and then it tries to extrapolate a summary from there. This introduces many caveats. First, the AI is unable to detect pronunciation issues because it only processes textual data and does not directly handle audio input. It does not help the case that the algorithm that transcribes the meeting overlooks pronunciation problems and tries to approximate the words accurately in the script. If the Zoom-AI algorithm can distinguish and transcribe the word, no mispronunciation would be detected, even if the student mispronounced a word or a phrase. This could result in the algorithm simply writing, "Jack also corrected Paul's pronunciation and grammar in a few instances," with no awareness of what the pronunciation problem was to begin with. It is worth noting that narrow AI models—those designed to perform a single specific task—capable of detecting pronunciation errors do exist (Nazir et al., 2023). However, they have not yet been integrated into Zoom-AI or other large language models.

On the other hand, humans can detect these problems and describe them as well. For example, Participant 6 writes, "Meanwhile, again, they focused on the pronunciation of the word *of*. The teacher said that the word was pronounced with *v* sound", so the teacher could *hear* what is being talked about. Alas, this is one of few instances where the correction is mentioned since most participants elected not to do so.

Another side effect of the non-awareness of the AI is that it is also *blind*. Because it only processes the text-based transcript, the AI cannot discern what is displayed on the screen. Consequently, its summaries lack any reference to visual elements, unlike the human-generated summaries that clearly describe what is being shown *visually*. For example, Participant 10 writes "The teacher showed some sentences sharing his screen . . ." which is not mentioned anywhere in the Zoom-AI summary but mentioned by most human participants. It is impressive that the AI can *guess* if something is shown on the screen from the transcription itself. For example, if the teacher says, "Now, I will share my screen". The AI can include that in the summary but as aforementioned, it is a guess because it is *blind*. Thus, though AI has been proven to be capable of summarizing the texts of academic learning materials efficiently and comprehensibly (Krishnaveni & Balasundaram, 2021), it falls short when it comes to summarizing a recorded lesson.

The final consequence of Zoom-AI's lack of contextual awareness is its failure to recognize that it is dealing with a lesson. By contrast, teachers who summarize the same content know it is a lesson and, therefore, make context-specific decisions—such as what to include or omit—based on the assumptions and dynamics inherent to the classroom setting, as discussed above. Teachers understand the dynamics between the individuals in the video recording. A simple example of this is that the AI always referred to the people in the lesson by their name: ". . . *Jack* and *Paul* had a discussion about video games, with *Jack* sharing his experience playing a game and *Paul* expressing his intention to play a new expansion . . ." The use of names throughout the summary generated by the AI misses the nuances of the power dynamic and the roles of each speaker in the lesson. However, if we compare this to the teacher's generated summaries, we see that they almost always made a distinction and called Jack "the teacher" and Paul "the student" or at least showed the roles by using other words such as "provides feedback" which assigns a role to that speaker. For example, Participant 7 writes, "*The teacher* provides help with the pronunciations of some words. After that, the teacher gives time to his student to match the words with the definitions on the right . . .". The power dynamic is clearly pronounced which sets expectations and the goals of what is being said throughout the discourse. This is a significant limitation in the context of education, where understanding the roles and dynamics is crucial for interpreting the interactions and outcomes of a lesson. The AI's approach, while objective, misses the subtleties of classroom interactions that are pivotal in educational discourse.

The importance of recognizing power dynamics and roles in educational settings is supported by research in the field of educational technology. For instance, Ifenthaler and Schumacher (2023) discuss

the integration of human and artificial intelligence in education, emphasizing the need for AI systems that understand and adapt to the complex dynamics of learning and teaching environments. Perhaps, this limitation is one of the most critical obstacles that must be addressed before further integrating AI into classroom interactions.

Lastly, we come to the aspect of language accuracy in the summaries. While the AI-generated summary was found to be free of linguistic mistakes, the human-generated summaries collectively contained a significant amount of language errors, including instances of ambiguity. This difference highlights a notable advantage of AI in terms of producing linguistically accurate content. For instance, human summaries suffered from unclear references and ambiguous phrasing, primarily due to the overuse of pronouns. In contrast, the AI, adhering to a strictly literal and structured use of language, avoided such ambiguities by frequently mentioning the names of the speakers. For example, the AI summary contained only six instances of the pronoun *he*, compared to 30 instances in Participant 2's summary, 13 in Participant 3's, and 20 in Participant 6's. This is particularly noteworthy since both the student and the teacher in the lesson are male, making the overuse of *he* in human summaries a source of potential confusion. The AI's approach of specifying names contributes to its clarity and precision on the text level.

Pedagogical and Broader Implications for AI in Education

The findings from this study highlight *some* potential for AI-generated summaries in educational contexts. While these summaries offer significant utility for administrative and logistical purposes such as lesson documentation, as noted by Chhatwal et al. (2023), allowing teachers to dedicate more time to complex aspects of instruction and pedagogical innovation. However, they currently fall short of delivering the interpretive depth necessary for reflective practice and teacher development.. By contrast, human-generated summaries, although variable in quality, offer deeper pedagogical insights, including justifications for instructional choices and feedback processes essential for fostering teacher growth and improving classroom practices. However, the inconsistencies in human summaries, evident in omissions, misunderstandings, and linguistic errors, show the need for systematic training in summarization and reflective writing for educators. Thus, perhaps integrating AI tools into teacher training programs could bridge these gaps. By using AI-generated summaries as benchmarks, educators could compare their narratives with AI outputs to identify missing details, enhance objectivity, and improve linguistic precision. This approach might be able to refine teachers' summarization skills and provide a foundation for reflective practice, especially if the AI model was trained on a specialty dataset related to education.

Addressing these limitations will require interdisciplinary collaboration among educators, technologists, and linguists to refine AI tools for educational purposes. Equally important is tackling the digital divide, as equitable access to AI tools ensures widespread adoption and effectiveness in diverse educational settings. By balancing AI's logistical strengths with human educators' interpretive capabilities, the integration of AI in education can be optimized to support both teaching and learning outcomes.

Practical Applications and Recommendations

The discussion points raised in the study suggest that while Zoom-AI-generated summaries have limitations as standalone tools for educational purposes, they can be significantly enhanced through a human-in-the-loop system (Memarian & Doleck, 2024). This approach, where AI-generated content is initially produced but then reviewed by human supervision if it had a low confidence of accuracy would ensure the quality of the AI's output while reducing the workload for educators. Figure 1 (Ostwal, 2023) shows how a human-in-the-loop system would mainly work.

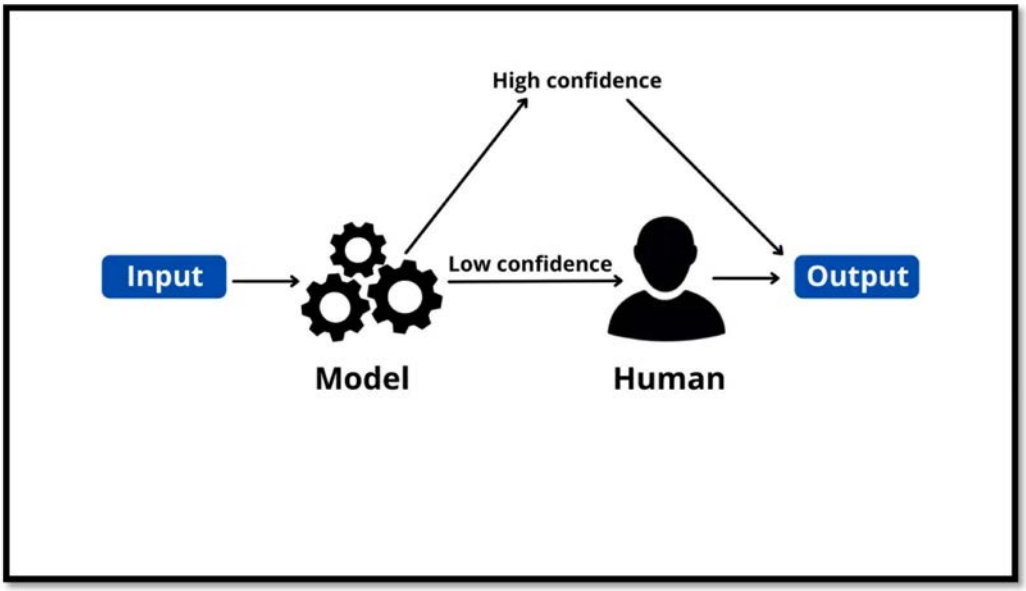

Figure 1 *A Human-in-the-Loop System.*

In the context of student notes, AI-generated summaries alone may not capture essential elements such as feedback and lexical items effectively. However, when these AI outputs are overseen and modified by educators, they can be transformed into more valuable educational resources. This approach allows teachers to focus on making critical modifications rather than creating summaries from scratch, thereby optimizing their time and effort.

Similarly, for observation summaries in Professional Development (PD) programs for pre-service teachers, the lack of educational judgment in AI-generated summaries can be compensated for by experienced educators. By reviewing and adding their insights to these summaries, teachers can ensure that the summaries serve their intended pedagogical purpose.

Research supports the effectiveness of such human-in-the-loop systems in educational settings. For instance, Datta et al. (2021) demonstrated the practicality of incorporating a human-in-the-loop approach for data collection and system evaluation in an AI-based classroom simulator. In addition, Ostheimer et al. (2021) emphasized the necessity of hybrid intelligent systems, which combine human creativity and dynamic minds with machine logic and computation speed in order to achieve high accuracy and reliability in machine learning algorithms.

Finally, there should be more focus on *multimodality* in such uses since education is a complex interaction that requires more than analyzing text. Transformer-based multimodal learning has become a hot topic in AI research due to its recent success in various machine learning tasks (Xu et al., 2023). However, the technology for an LLM or a Zoom-AI-like model with these capabilities has still not been realized. Thus, to achieve this *multimodality*, the research proposes the use of layered AI models or even so-called *AI agents*. AI agents are *smaller* models that the primary AI model controls and assigns different tasks (Durante et al., 2024); in some cases, they can be completely independent as well. In such a case, Zoom-AI, or any other model, can be combined with AI agents responsible for specific tasks. For example, an AI agent/layer would only focus on pronunciation, and another one can visually inspect the lesson/screen. Then, these agents would report the findings to the main AI model to include it in its summary or whatever educational output is targeted. This is similar to what Rasheed et al. (2024) tested with multiple agents/layers actually to evaluate other LLMs. The AI

agents' approach has already been tested in the medical field (Schmidgall et al., 2024) and software development (Salinas-Navarro et al., 2024).

Limitations of the Study

This study is not without its limitations. The scope was limited to a single AI tool (Zoom- AI) and a specific educational setting, which may affect the generalizability of the findings. Additionally, the study did not measure the long-term effectiveness of using AI-generated summaries in educational practice. The relatively small sample size, consisting of 10 Turkish EFL teachers, further limits the generalizability of the findings to broader populations. Moreover, the lesson content was specific to a single topic, potentially influencing the results and limiting their applicability to other contexts. Ethical considerations, such as participant perceptions of AI and data privacy concerns, were not fully addressed but remain critical for broader acceptance and integration of AI tools in education. For those interested in replicating or extending this study, exploring different AI tools across diverse educational contexts and lesson types could provide a more comprehensive understanding of AI's applicability and effectiveness in this type of summarization.

Conclusion

This study compared human-generated and AI-generated summaries in an educational context, revealing distinct strengths and limitations in both. The AI-generated summary, produced by Zoom-AI, demonstrated efficiency, completing the task in just 4 minutes compared to the average of 92 minutes taken by human educators. However, it lacked pedagogical judgment and contextual understanding. Human summaries provided valuable educational insights and a nuanced understanding of classroom dynamics but still lacked practical educational value.

The findings suggest a complementary approach, integrating AI's efficiency with human expertise, ideally through a human-in-the-loop system. This approach can optimize educators' time, allowing them to focus on enhancing AI-generated content rather than creating summaries from scratch. Future research should focus on enhancing AI's ability to understand and replicate pedagogical judgment and contextual nuances, exploring the integration of multimodal AI that can process audio and visual cues, and examining the long-term impact of using AI-generated summaries on educators' workload and student learning outcomes. Failing that, implementing an AI agents' approach could be a solution to mitigate the shortcomings of the Zoom-AI model i.e. to give it *eyes* and *ears*.

Use of Generative AI

This manuscript‑made use of ChatGPT to assist in paraphrasing and improving the clarity of text and consensus for finding relevant literature. No AI tools were used for the‑generation of research hypotheses or the writing of conclusions. The listed authors authored and reviewed the final manuscript without additional AI input.

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Appendix

The Complete Lesson Plan

Video Link: https://youtu.be/iYEx2m0x5aw

PREVIEW ACTIVITY (I)

Work with a partner, group, or your teacher. Do the activities below together.

PART I Discuss the questions below on the right about the man in the image.

"Cyborg Pride and Identity" by Anna Hanks used under CC BY 2.0.

1. What do you think is on the man's head?
2. Why do you think it's on his head?
3. How do you think it got on his head?

PART II Do you **agree (A)** or **disagree (D)** with the following statements? Explain your answer.

A	D		
☐	☐	1	Mobile phones have become part of the human body.
☐	☐	2	People spend way too much time in front of digital screens.
☐	☐	3	Technology causes me too many problems.

PART III Discuss the questions below about **disabilities**.

1. How can disabilities affect people?
2. What kind of technology exists to help people with disabilities?
3. Imagine you're explaining what color is to a blind person. What do you say?

PART IV Explain the function of the following tools / objects below:

HEADPHONES

ANTENNA

SATELLITE

PART V Read the words below out loud. Your teacher will correct your pronunciation. You will learn the meaning of the words later in the lesson.

1 *cyborg* 2 *skull* 3 *frequencies* 4 *sight* 5 *achromatism*

PREVIEW ACTIVITY (II)

PART I Match the **nouns** with their definitions below the context examples.

1 *Joseph lost his **sight** as a baby, so he has been blind for most of his life.*

2 *In our anatomy course in school, we studied the human skeleton and the **skull**.*

3 *When I lost my tooth, I had to get a dental **implant**.*

4 *Before launching the product on the market, the company tested a **prototype**.*

5 *Each color on the visible spectrum has a different light **frequency**.*

1 ☐	sight	**a.** something permanently inserted into the body
2 ☐	skull	**b.** vision; physical ability to see
3 ☐	implant	**c.** sample or model
4 ☐	prototype	**d.** a scientific term for the rate at which waves move up and down
5 ☐	frequency	**e.** the bone structure that surrounds and protects the head

PART II Choose the correct definition for the **verbs** / **phrasal verbs** below.

1 *The police use radars to **pick up** the speed of cars on the highway.*

pick up means...
- ☐ **a.** detect or receive a type of signal or sound
- ☐ **b.** change the physical form or shape of something
- ☐ **c.** attract or make somebody like something

2 *Each ID number in the system **corresponds to** a customer in our database.*

correspond to means...
- ☐ **a.** grow or become larger in size
- ☐ **b.** push or move forward
- ☐ **c.** match, agree, or correlate with

3 *My phone **vibrates** every time I get a new message or phone call.*

vibrate means...
- ☐ **a.** take something with your hand
- ☐ **b.** break into small pieces
- ☐ **c.** move or shake rapidly

4 *Technology keeps **evolving** at an incredible rate.*

evolve means...
- ☐ **a.** break slowly or become damaged over time
- ☐ **b.** develop or change gradually throughout time
- ☐ **c.** slowly learn or gain something new

Bonus Term!

cyborg A hybrid of a human and a machine; a human being with robotic implants or mechanical body parts that are controlled by computers

HUMAN CYBORG WITH IMPLANTED ANTENNA

"Cyborg Pride and Identity" by Anna Hanks used under CC BY 2.0.

PREVIEW DISCUSSION QUESTION

What kinds of interesting medical or health technology have you heard or read about?

VIEWING ACTIVITY

PART I Write short answers below according to the information from the video.

0:16 **1** How does Neil's antenna work? What does it allow him to do?

0:42 **2** What is "achromatism"?

0:49 **3** Describe the prototype project that Neil was involved in in 2003.

1:29 **4** What is the next object that will be implanted inside Neil's body? What will its function be?

PART II Choose true or false according to the information in the video.

0:01 **1** **TRUE** ☐ **FALSE** ☐ Neil says the antenna feels like it's a normal part of his body.

0:42 **2** **TRUE** ☐ **FALSE** ☐ Neil got the antenna implants when he was 11 years old.

1:12 **3** **TRUE** ☐ **FALSE** ☐ Neil has one implant in the back of his head.

1:21 **4** **TRUE** ☐ **FALSE** ☐ Neil's implant blocks signals from satellites.

POST-VIEWING ACTIVITY (I)

PART I Choose the correct **word**, **verb form**, or **part of speech** used in each sentence below.

1 *My antenna doesn't feel* ***any*** / ***some*** *different from any other part of my body.*

2 *It allows me* ***hear*** / ***to hear*** *the sound of colors.*

3 *Each color has* ***it's*** / ***its*** *own vibration.*

4 *Each color* ***vibrates*** / ***vibration*** *differently in my head,* ***which*** / ***what*** *then corresponds to a different note, or a different sound.*

5 *It keeps* ***evolving*** / ***evolve*** *and the next stage now is to add a bluetooth tooth.*

PART II Read the sentences aloud. Your teacher will correct your pronunciation.

1 *"The antenna is implanted inside my head and it allows me to hear the sound of color."*

2 *"The first prototype was a webcam connected to a 5 kilo computer and a pair of headphones."*

3 *"I was actually using my ears in the beginning to hear color, but I didn't like this because it was blocking an existing sense."*

4 *"The next stage now is to add a bluetooth tooth in my mouth that will allow me to control the antenna."*

PART III Rewrite each sentence. Replace the <u>underlined words</u> with words used in the video.

EX The antenna <u>gives me the ability</u> to hear the sound of color.

The antenna allows me to hear the sound of color.

1 The vibrations travel through my <u>bone structure in the head</u>.

2 It's a light sensor that <u>detects</u> the light frequencies in front of me.

3 I wanted to have a new sense for color independently from <u>the physical ability to see</u> and hearing.

POST-VIEWING ACTIVITY (II)

SPEAKING TASK:

Your teacher will choose a few of the speaking topics below to discuss. Discuss the topics with your teacher or partner. In your discussion, explain your ideas in detail.

1. Neil said that he was 11 years old when he first realized that he was colorblind. How do you think colorblind people find out or realize that they're actually colorblind?

"Neil Harbisson" by Neil Harbisson used under CC BY 2.0.

2. If you were colorblind, would you like for an antenna to be implanted in your head? What kinds of problems do you think Neil experiences with the antenna on his head?

3. What do you think about the idea of an electronic chip being implanted inside of you?

4. Can you think of any other examples of technology that exist today that we attach to our bodies? Describe the purpose of the technology and what it's used for.

5. Can you imagine what some of the next evolutionary steps in Neil's antenna device might involve? What do you think his antenna may be able to do in the future?

WRITING TASK:

Imagine you're an author who is writing a futuristic science fiction novel about cyborgs. Come up with a title for the book and a plot description (2 - 4 sentences describing what the novel is about).

TITLE:

PLOT DESCRIPTION: This book is about...

QUIZ & REVIEW ACTIVITY

Work with a partner. Complete the quiz and review activities below.

PART I **Questions.** Answer the questions below about the video.

1. Why does Neil have an antenna and how does it work?
2. What happened when Neil was 11 years old?
3. How was the original prototype different than the one he has now?
4. What is the next object that will be implanted inside of Neil's body?
5. What does Neil say about his implants and satellites?

PART II **Vocabulary**: Discuss what each term means. Write how it was used in the video.

1. **skull** _____
2. **pick up** _____
3. **correspond to** _____
4. **sight** _____
5. **evolve** _____

PART III Write the correct word, verb form, or part of speech missing from each sentence below.

1 *My antenna doesn't feel* _____ *different from any other part of my body.*

2 *It allows me* _____ *the sound of colors.*

3 *Each color has* _____ *own vibration.*

4 *Each color* _____ *differently in my head,* _____ *then corresponds to a different note, or a different sound.*

PART IV **Bonus**: Imagine you're Neil from the video. You just got your new "bluetooth tooth". Write a short social media post about your experience with your new tooth.