



Original article

AI-Supported English Learning at Al-Amal Institute for the Deaf and Speech-Impaired: A Case Study

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ABSTRACT

This is a case study that examines how the Deaf and Speech-Impaired, Artificial Intelligence (AI) is used to facilitate English language learning. It is known that because of hearing loss, deaf and hard-of-hearing people struggle to learn English. This study aims to investigate the efficacy of utilizing AI tools to enhance and strengthen their reading and writing skills in English language. The study also explores the perceptions of D/HH students and their educators in implementing AI in their learning, identifying both positive and negative aspects to this method within their individualized setting. I will employ a combination of interviews, observations and document reviews to provide a look into how AI is implemented and its effectiveness as well as perspectives on the benefits and drawbacks. This research will provide evaluation evidence for teachers, policymakers, and tech developers to design better inclusive English learning spaces for D/HH people.

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Keywords: AI-assisted learning, Deaf and hard-of-hearing (D/HH), English language education

تعليم اللغة الإنجليزية المدعوم بالذكاء الاصطناعي في معهد الأمل للصم وضعاف النطق: دراسة حالة

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المستخلص

تتناول هذه الدراسة الحالة كيفية استخدام الذكاء الاصطناعي في معهد الأمل للصم وضعاف السمع لتيسير تعلم اللغة الإنجليزية. ومن المعروف أن الصم وضعاف السمع يواجهون صعوبة في تعلم اللغة الإنجليزية بسبب ضعف قدرتهم السمعية. تهدف هذه الدراسة إلى بحث فعالية استخدام أدوات الذكاء الاصطناعي في تعزيز مهارات القراءة والكتابة باللغة الإنجليزية لدى هؤلاء الطلاب. كما تستكشف الدراسة آراء الطلاب الصم وضعاف السمع ومعلميهم حول تطبيق الذكاء الاصطناعي في عملية التعلم، مع تحديد الجوانب الإيجابية والسلبية لهذه الطريقة ضمن بيئتهم التعليمية.

ولتحقيق أهداف الدراسة، سيتم استخدام مزيج من المقابلات والملاحظات ومراجعة الوثائق، بهدف تقديم نظرة معمقة حول كيفية تطبيق الذكاء الاصطناعي وفعاليته، إضافة إلى استكشاف وجهات النظر المختلفة حول فوائده وعيوبه المحتملة. ومن المتوقع أن يوفر هذا البحث أدلة تقييمية قوية ومعلومات مفيدة للمعلمين وصناع السياسات ومطوري التكنولوجيا، بما يساهم في تصميم بيئات تعليمية أفضل وأكثر شمولاً لتعليم اللغة الإنجليزية للصم وضعاف السمع.

الكلمات المفتاحية: التعلم بمساعدة الذكاء الاصطناعي، الصم وضعاف السمع، تعليم اللغة الإنجليزية

1. Introduction

Deaf and hard of hearing (D/HH) individuals usually face significant obstacles in the acquisition of English language skills, particularly concerning reading and writing proficiency. In his article, “Enhancing EFL writing skills for adult Deaf and hard of hearing individuals. *Frontiers in Education*”, Chomicz states how using internet tools can help Deaf and hard of hearing (D/HH) adults improve their English as Foreign Language writing skills. The findings suggest that these tools can really make a difference. He finds that these tools can truly make a difference as participants feel that their vocabulary, grammar, and overall writing flow have improved, and their confidence in writing has grown. Chomicz adds that D/HH learners are creative in their writing. They use simple words, fun stories, and cool visuals to share their ideas, even without tech. The internet has made these natural skills even better, helping them write more clearly and organize their thoughts well.

This may reduce students' independence in language learning because of overreliance on technology. Therefore, he recommends the combination of technology and traditional methods as the best way to do it. However, we believe that this balanced approach is the most effective means of enabling D/HH learners to develop all of their EFL skills successfully.

AI is a game changer in many fields and one of them is education. It provides excellent opportunities for customizing learning pathways and overcoming traditional barriers. We are even seeing approaches like these encompass that speech recognition, natural language processing, intelligent tutoring systems (ITS) and adaptive learning platforms to assess their ability to enhance academic performance and communication skills through adaptive support. (Hussein et al., 2025) According to Levesque et al. (2023): The evolution of AI has aided the remarkable progress in assistive technologies like smart hearing aids and automatic speech recognition. Advancing natural language processing for signed and spoken languages thus enabling new horizontal inclusive learning environments.

While it may be counterintuitive that D/HH students learning online are often without appropriate supports, Cheng et al. (2024) show that the outcomes of previously developed AI tutors through big language models can serve this population. D/HH students' use of AI tutors were more willing to trust them if they have experience teaching students who are D/HH. These AI tutors were comfortable and understood culture of D/HH community, that is why my conversation with them was natural and human-like This was a finding which solidified the fact that creating an AI tutor for D/HH learners will require to create great personality for those AI so that they could sympathize with their nature and understand what does it mean being someone from D/HH community, and how we need to interact properly with them, this will significantly increase learning through ease interactions.

Alkahtani (2024). demonstrates that the new generation of Artificial Intelligence tools are very exciting and able to construct good assistance for Deaf and hard-of-hearing (D/HH) young people Technologies based on automatic speech recognition, natural language processing (which is putting meaning into uttered speech), smart tutoring system are momentous making comforts against D/HH students become communicate, learn, inclusion, independency. Once all these tools are introduced (inclusively a lot of barriers fall down and potentially D/HH students have more engaged in classes, growing their academic capabilities), he explains. He also told us that even if AI sounds convenient, there are other things we need to consider. Some research on this topic has been small, he notes, and we have no long-term data. He also provides a sense that these new technologies aren't available to everyone. Due to these problems, more specific research is necessary in order to completely understand the advantages. And, for the moment, it seems that judicious and purposeful use of AI can be extremely helpful to D/HH students.

Nisha & Gill (2024) explain how to accommodate the reading and writing skills of Deaf and hard-of-healing students. They explain how emerging technology, like Skybox AI, can help make learning easier and more fun for these students. The AI can generate images based on what students are reading or writing about, which supports their comprehension and retention of information. They show that AI tools can be very helpful in the education of children with hearing impairments. When they create images that accompany the lessons, students can learn more efficiently and feel a greater sense of investment. This technology can make learning easier and more enjoyable for deaf and hard of hearing learners.

They find that AI tools like Skybox AI are especially good at enhancing the reading and writing skills of students who are deaf or hard of hearing. Visually creating useful graphics to facilitate

their learning; Such technologies ease education and education becomes more engaging & energizing. Therefore, the authors propose using AI image generators in their instruction for students to process. Students will remember with more intended when including tools like these into teaching instructions while making learning more enjoyable and interesting.

This study also provides a case study in depth analysis of special Education schools represented by the Al-Amal Institute for the Deaf and Speech-Impaired in Baghdad. The study will also examine the demographic as well as academic population (usage v/s impact) of AI-augmented English learning solutions in this unique context. In this way, this study aims to explore a growing area of research surrounding how AI tools can be used to support the development of reading and writing in English, student engagement, and well as D/HH learner's specific learning challenges through a local lens. Results of this broad study offer valuable perspectives about the effects and potential role of Artificial Intelligence while also finding solutions in overcoming obstacles and challenges surrounding use within a D/HH English learning classroom setting.

2. Problem Statement

It is noticeable that Deaf and hard of hearing (D/HH) people face many challenges in learning English, particularly in relation to reading/writing. That is because hearing problems can have a serious effect on language development. Therefore, they do not get a proper education thus less opportunity to interact. In many schools, the gap is compounded by a shortage of qualified sign language teachers and interpreters an issue that especially affects Deaf students. While D/HH has used assistive technologies to establish communication in the past, they face unique challenges learning languages that can inhibit their academic success and inclusion in society. Due to limited resources available for the teaching of English Language Learners and specialized methods such as scaffolding, we must be creative in finding new ways that works for those who are emergent bilingual.

3. Objectives

The main goals of this study are:

- It will explain how good AI tools assist D/HH students to enhance their English reading and writing skills at Al-Amal Institute as mentioned by Nisha & Gill in 2024.
- To explore the perspectives of D/HH students and their teachers on whether, if at all, they use AI to learn English at the institute.
- More precisely, in order to determine the potential opportunities and challenges posed by implementation of AI technology inside the classroom and for teaching practices among D/HH learners.
- To provide ideas for effectively implementing and scaling AI-powered English learning solutions to D/HH learners in similar schools.
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4. Research Questions

The research questions this study is trying to answer are:

- To what extent do AI-assisted programs aid D/HH Al-Amal Institute students in enhancing their English reading and writing abilities?
- What are the perspectives of D/HH students and teachers on using AI tools to learn English in Al-Amal Institute?
- What is the most important factor for or against effectively utilizing AI to teach English to D/HH students at Al-Amal Institute?
- How will AI technologies address the unique communication and learning needs of D/HH students when learning English?
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5. Methodology

This study will employ a qualitative case study approach, which is especially useful to investigate an area in depth of a specific real-world, current phenomenon.

The study sample will be only of Al-Amal Institute for the Deaf and Speech-Impaired. Sample and participants: The sample will include D/HH students who study English language at Al-Amal Institute, and their teachers of English language. The number of participants depends on the population and how accessible is the institute. Average pass is 36 higher secondary students which in line with other comparative studies.

Data Collection Methods:

We will triangulate multiple data sources for rich insights: Interviews: We will undertake semi-structured interviews with D/HH students to understand their experiences and views around AI tools, learning practices, as well as barriers they encounter. We'll also be gathering information from teachers around their pedagogies, what they are seeing with student engagement, and how they feel about AI.

- Observation: In addition to visiting classrooms, we'll also be looking closely at the ways in which students interact with AI tools when introduced to them, and how teachers navigate that interaction.
- Document Analysis: Documents that will be reviewed in addition to obtaining information through interviews and observations include curricular material, student performance logs and AI program usage data (if available).
- Pre and Post Assessments: To measure any changes in their competencies over time, standardized English reading and writing tests will be administered prior to the AI intervention as well as after it concludes.

6. Literature Review

Zdravkova et al. In (2022) "Cutting-edge communication and learning assistive technologies for disabled children: An artificial intelligence perspective"; the authors provide a comprehensive review and analysis on leveraging Artificial Intelligence to design state-of-the-art assistive technologies focused on communication and cognitive improvement aimed at special needs teenagers. The paper discusses a few disabilities and reviews the recent technologies that aid these children for communication and learning, as well as the AI approaches set on the background of

these systems. The paper divides AI methods into four categories, including augmentative and alternative communication that help with basic needs conversion, machine learning and deep learning, natural language processing (NLP), conversational AI. These could be AI tools using gesture-based text prediction for hard of hearing children, brain-computer interfaces that increase independence among people living with movement disabilities.

They also touch on future-particular AI in the forms of assistive technologies, and draw attention to key ethics questions that arise concerning whether or not particularly advanced communication and learning tools should be used by disabled children.

They emphasize that good communication is necessary for quality education, and that disabilities can inhibit a student's ability to learn and participate fully. This will help building more inclusive and effective spaces for learning.

Coy et al. (2024) discuss the issues facing Deaf pupils particularly within the Global South, where it can be challenging to receive an equitable education in inclusive classes or institutions. These are due to a lack of well-signing teachers, a shortage of interpreters and an insufficient number of trained Deaf education teachers. To this end, the paper investigates two streams with artificial intelligence used to develop a system that enables real-time communication between Deaf students and non-signing teachers. The proposed solution combines multiple areas of AI, including speech and language processing, computer vision, machine translation and 3-D avatars. This "closed-loop" system is intended to use new developments in gesture recognition, translation and speech technology so Deaf students and hearing teachers can converse through their preferred methods. With the help of AI, the goal is to make learning easier and more engaging for Deaf students.

Nisha & Gill (2024) investigate the use of Artificial Intelligence, in particular via Skybox AI (a 3D AI application developed by Blockade Labs), to support English literacy among Deaf and hard-of-hearing learners. For this study, the researchers analyzed 36 DHH students from two higher secondary school established for hearing-impaired students. The idea was to discover whether generating visual images from sentences with the help of AI could genuinely offer support to DHH students in developing better language skills.

But the current researches also reveal many issues and key elements. This has resulted in several challenges, including limitations of the datasets available to D-M communication for potential applications, difficulty achieving full real-time processing for many Real-Time Embedded systems implementations; and a lack of research on more complex forms of Human-robot interaction beyond straightforward Gestural detection. Concerns also include inequality in access to AI technologies in low-resource settings, the necessary widespread teaching about these technologies which may or may not be attainable, ethical issues concerning data privacy and algorithmic bias that should be taken into account when implementing such systems. Although the earlier studies have had some inclination towards potential benefits, there is clearly a lack of more comparative and long-term research to back up the claim.

7. Discussion

Thus, this critical discussion will be anchored with evidence coming from a case study of the Al-Amal Institute, illustrating how AI works for D/HH English language learners and promise of

similar technologies in the near future for special education. It is anticipated that findings will illustrate how AI can create personalized learning paths tailored to the specific language and communication requirements of D/HH students while also raising interest, engagement, or investment in studying English. By looking at what worked and what did not, the study will provide actionable insights for teachers, policy makers and tech developers. It will show them how best to help integrate AI tools into existing lesson plans, and indicate where ramped up tech upgrades or teaching aide support is required. Ultimately, this exploration informs the discourse on increasing inclusive and effective environments for D/HH English learners associated with powerful affordances of AI along with important ethical considerations and access issues.

8. Interviews: D/HH Students and AI Tools in Learning (with sign descriptions):

These interviews were conducted by the researchers at Al- Amal Institutes in Baghdad.

Interviewer: (Signs: Hello, welcome. Today, we want to discuss how you use AI in school and your thoughts on it.) (The interviewer starts by waving with an open hand to greet. Then, they point to themselves and to the students, making a sweeping gesture to indicate "today." They use signs for "talk" (tapping an index finger on their chin repeatedly) and "AI" (spelling out A-I or using a common sign for artificial intelligence, often by signing "smart" and "machine"), with a questioning look for "what do you think?")

Student 1: (Signs: Hi, I'm excited to share what I think.) (Student 1 shows "hi" by putting their open hand near their forehead and moving it outwards. Then, they sign "excited" by brushing their open hand up on their chest. They finish with signs for "share" (hands cupped moving away from each other) and "what I think" (tapping an index finger on their temple or forehead repeatedly).)

Student 2: (Signs: Same here. It's a cool subject.) (Student 2 signs "same here" by pointing to themselves and then making a "same" gesture (two index fingers moving side by side). They then sign "cool" by making a grabbing motion with both hands at the center of their chest, and "subject" by tapping their index finger on their other palm.)

Interviewer: (Signs: Let's kick things off with a broad question. What AI tools, if any, do you use for your studies, and in what ways do they assist you?) (The interviewer indicates "start" by pointing forward with an index finger, then gestures "broad question" with an open hand moving in a circle, followed by a questioning hand shape. They then sign "AI tools" by using the sign for AI and then forming "tools" with both hands as if holding tools. They end with open hands (one hand lifting the other up) signing "how assist you." Sarah: (Points at sign, holds up phone) I sometimes use some transcription app on my phone. If in class, it helps me follow along with the lectures as teachers do not have good interpreters, or I miss something. It converts spoken words into text. It's not flawless, but it helps me catch up quickly.) (Sarah points to herself for "I," then signs "use" by bringing her dominant hand towards her non-dominant hand. She pretends to hold a phone and signs "app" by tapping an open palm. She uses signs for "transcription" by bringing her dominant hand from the side to the center of her non-dominant palm, then "sometimes" (repeated downward motion of an open hand). She then signs "help me" with an open upward motion towards herself, followed by signs for "keep up with lectures" (hands mimicking following text, then lecture as if speaking), "teacher," "no good interpreter" (shaking head for "no good"),

and "miss something" (a brief, quick closing of the hand). She describes "converts spoken words into text" by moving her hand from her mouth to a flat palm. She concludes by signing "not flawless" with a wagging finger, but "helps me catch up quickly" with a rapid upward motion of her hand.)

Ahmed: (Signs: I have a dictionary powered by AI that can show me pictures and definitions when I read difficult English texts. It's super helpful for learning new words, especially when I find words that don't have a clear sign or when the meaning is a bit tricky. Also, sometimes I use a generative AI to make long articles shorter, which helps me understand a lot of information faster. (Ahmed points to himself for I, then signs have and AI-powered dictionary (pretend-looks up a word. He signs "show me" with his hand pointing to his eyes, and then the word for "pictures," which consists of round motions made around the eyes. He signs "definitions" by tapping his index finger on his other palm. He shows "reading difficult English texts" by pretending to hold a book and then making a scrunched face for "difficult." He emphasizes "super helpful for learning new words" with a big nod and signs for "words," "no clear sign," and "meaning tricky." He then signs "sometimes I use generative AI to make long articles shorter" (pretending to shorten a long object), and "helps me understand a lot of information faster" with a quick, organized hand movement.

Interviewer: (Signs: That's awesome to hear! Can you share a specific moment when an AI tool really helped you learn or understand something better?) (The interviewer signs "awesome to hear" by moving an open hand from the ear to a thumb-up. They then sign "specific moment" by tapping an index finger, followed by "AI tool really helped" with a big hand gesture, and "understand something better" by tapping their forehead.) Sarah: (Signs: Yes! In history class, we were watching a documentary with closed captions, but sometimes the captions were too fast or wrong. I used my transcription app at the same time. It could listen to the audio and provide me with a text stream that was more accurate and slower, which made it easier to fill in historical details I had missed previously. (Like I finally was getting everything the first time.) (Sarah excitedly signs "yes!" She signs "history class" next by forming what she refers to as an "H" handshape and moving it in a circle on her palm, then "watching documentary," making circular motions with her hands like she's watching a screen. She writes "closed captions" with lines drawn across her palm, then "sometimes captions too fast or wrong" with a movement that is fast and messy, face confused. She fingerspells "transcription app" simultaneously with the sign for "at the same time," meaning both things were happening at once. She points to "listen to audio" by putting her palm up against her ear and opening her hand, "give me more accurate and slower text stream" with slow, careful gestures. She finishes by signing "understand historical details I was missing before" (with a strong grasping motion) and then the happy expression "finally getting everything the first time.)

Ahmed: (Signs: For me, it was science that was the subject. We were learning about complicated biological processes, and the teacher was using a lot of difficult terms. I fed the text descriptions into an AI image generator, and used it to create pictures of these processes. Seeing the concepts graphically, like a self-made mind map, helped me understand them much better than I would have by reading alone. It literally revolutionized how difficult concepts are understood." (Ahmed gestures to himself for "me," then signs "science" by making a hand in an "s" shape and moving

it in a circle. He gestures “learning complicated biological processes” and flashes a serious face, followed by a twisting motion from his other hand for “processes.” With a vague, round hand movement, he shows “teacher using abstract terms.” He uses “AI image generator” while mimicking drawing, and “create visual representations,” making an exaggerated hands gesture. He is saying “based on text descriptions” while moving his hands from a written form to a visual representation. He gestures with an open hand in front of his eyes and mentions “seeing concepts visually, like a custom diagram.” He signs, as his sign-off: “helped me understand much better than just reading” and “game changer for visualizing complex ideas,” with a strong, transformative gesture.)

Interviewer: (Signs: It sounds like AI has these really strong benefits. But what are the biggest problems, or annoyances, you have encountered when using A.I. tools for your education?)

SIGNING: AI strong benefits (upward motion) Then they shift to a questioning expression, and then sign “biggest problems” by displaying a big, blocking obstruction; and “annoyances” by twisting their hand in front of them. They then sign “using AI tools for education,” with hands that appear to ask a question.) Sarah: (Signs the biggest problem is accuracy. The transcription apps sometimes have errors, especially with technical terminology or when many people are speaking. It can baffle me, and I have to work harder to tease out what the speaker really said. (And not all the teachers are familiar with these tools, either so for challenge II feel like an island looking for what to do.) (Sarah makes a “C” with her hand, moving it across the palm of her other to indicate what direction is precision (accurate), shakes her head when prompted to identify the biggest problem.) She uses this odd babbling gesture when she signs “transcription apps mess up,” especially with words like “technical (precision)” or “a lot of people talking” (simulating a crowd). She signs “confusing” by spinning a hand around her head, and “take extra time to figure out” with slow, cautious digging. She adds what appears to be a gesture of isolation, signing “not all teachers know about tools,” and that “sometimes I feel alone trying to find answers.”

Ahmed: (Signs: I like Sarah's opinion about accuracy. Another challenge is integration. It would be more well-integrated with our learning platforms as opposed to being standalone apps. Also, sometimes AI is too generic or vague for me as a D/HH. We need AI that understands far better our styles of communication and learning. (Ahmed seems to agree with Sarah about his accuracy.) And then he signs “another challenge is integration” by using an image of two things that need to connect but are separate. It would be “amazing that the AI tools built directly into learning platforms,” he signs, with a big gesture indicating he wants them to flow seamlessly. He says that this avoids the notion of “having to use separate apps,” things that are not cross-connected. Then he signs using a horizontal gesture (indicating flat movement), “sometimes the AI-generated content too generic or not fine-tuned enough for my needs as D/HH student” (customization). He finishes with a resounding signing articulating “we need AI that understands how we communicate and learn differently” contrasting that last signature, “understand”, even more strongly with a big forward movement.

Interviewer: (SIGNS: You both gave us so much insightful, heart-wrenching stories about your experiences and the difficulties you’ve faced. (Other than what you posted about AI and your path to education)? (The interviewer signs “thank you both” with an open palm over each student, then

“sharing thoughtful experiences and challenges,” with a pensive expression and gestures as of dividing details by handing them out like papers.) They conclude with “anything else add about AI and education?” with an open, inviting gesture.) Sarah: (Signs: I think that AI can provide a new way to build inclusion in education for D/HH students. But developers will have to engage closely with us so these new tools are actually useful and serve our real needs, not necessarily the ones they think we need.) (Sarah takes pains to explain, “AI has potential,” arms wide and sweeping.) She next signs “make education truly inclusive for D/HH students” with a sweeping, hewing motion. Then, she fingerspells “developers need to work closely with us,” bringing her dominant hand behind the non-dominant one a sign of partnership. She imposes what I can only describe as a no-nonsense and firm toolset that in the “tools should be genuinely helpful and solve real problems, not just what they think we need” sense (the latter gets the wagging finger and slightly dismissive facial expression.)

Ahmed: (Signs: Yes, access and also access is very much important. Not everyone has the most up-to-date devices or internet access that enable us to use those tools to their full potential. To be of help, AI must be widely available and affordable for all D/HH students, especially in resource scarce areas. Ahmed makes a sign for “yes” and then adds, “and also access is really important,” making the “key” sign and then emphasizing. He gestures widely at a perceived lack and signs “not everyone has the newest devices or internet access,” followed by “to use tools well.” “With a powerful, inclusive gesture he states “for AI to truly help, it has to be easy to get and cheap for all D/HH students” He ends with “especially in areas that lack resources” by gesturing to a small, cramped space.)

Interviewer: (Signs: Thanks to both of you for your important time and truthful feedback.) (The interviewer signs "thanks to both of you" again and signs "important time" by placing a hand on their wrist, then "truthful feedback" with a genuine, open gesture.)

9. Q&A Interactions: AI-Supported English Learning for D/HH

Students Interaction 1: Understanding New Vocabulary

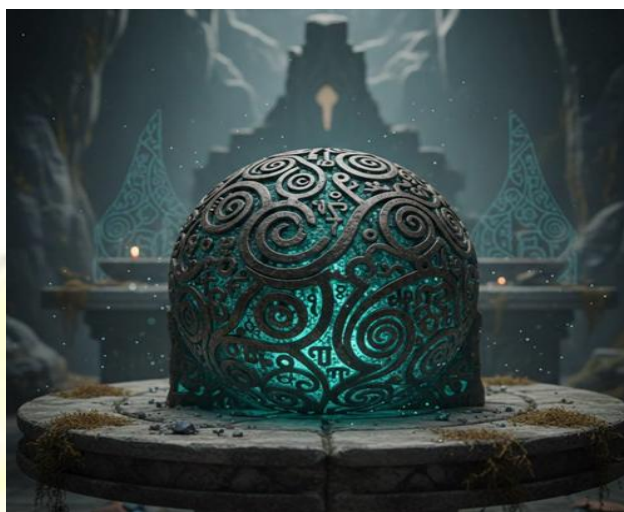
A. The student uses a sign language gesture for "NEW WORD" by placing their non-dominant hand flat, palm facing up, in front of them. Then, they take their dominant hand, shaped like a 'G' (with the index finger out), and tap it on the palm of the non-dominant hand. After that, they close their dominant hand into a fist on the palm. Next, they sign "MEANING" by raising both hands, palms facing each other, fingers spread out, and then bringing them together to touch the fingertips. Finally, they sign "SEE" by pointing to their eyes with the index finger of their dominant hand and then moving that hand forward.

B. Teacher's Interpretation of the Sign: "The student is asking: 'What does this new word mean? Can I see it in a picture?'

C. English Question/Answer: Student's Question (implied): "What does 'fascinating' mean? Can you show me?" Teacher's Response: "Fascinating means very interesting or captivating. Let's get some examples with the AI image generator.

D. How AI Tools Help: The teacher enters “fascinating examples” into an A.I. image generator (like gemini). It generates pictures such as a close up of an individual snowflake and an ancient

cartographic map with multicolor-represented coral reefs. This puts the context into a visual form, tying “fascinating” as an abstraction to tangible ideas that can be grasped.



E. Importance Note: Visual aids are accessible and important as D/HH learners depend mostly on visual abilities. AI image generators provide fast, meaningful visual examples, which contribute to linking a word with its real-world meaning, improving vocabulary learning and memory.

Students Interaction 2: Comprehension

A. Student signs word "READ," by sliding (their dominant) 'V' handshape, palm out through a 'palm up' station and a non-dominant palm ("like reading a book"), then signs the word UNDERSTAND by making an 'S' handshape with their dominant hand and bringing it to their forehead before opening it into a '5,' but while doing this they shake their head NO. They do this until signers know what the next step is; then they again sign "EXPLAIN" (they bring together both 'F' handshapes and then else apart in straight lines).

B. Teacher's Understanding of the Sign: "The student went through the text but didn't get it completely and is looking for some help."

C. English Question/Answer: o Student's Question (implied): "I read this part about photosynthesis, but I don't really get how it works. Can you explain it in a simple way?" Teacher's Answer: "Sure! Let's use our AI learning tool to break it down and give us an easier version or a summary."

D. How AI Tools Help: The teacher copies the hard paragraph into an AI tool that summarizes text. The Ai makes it easier and now highlight important subjects, even asked the user to create an infographic of photosynthesis what makes everything clear.

Response from AI Learning Platform: “Hello! I sought a more accessible way of describing photosynthesis. That’s a fascinating process that plants use to create their own food! Let us simplify it:

Easy Explanation of Photosynthesis

Plants, then, you can think of as little cooks and the sun as their big powerful oven. Photosynthesis is sort of the plant's special recipe for making its food. Here is how it works:

A. Ingredients:

To make their food, plants require three main "ingredients":

- **Sunlight:** They get energy from the sun.
- **Water:** They absorb water from the ground through their roots.
- **Carbon Dioxide:** This is a gas they take in from the air through tiny openings in their leaves.

B. The Kitchen:

Inside the leaves of a plant, there are tiny "kitchens" known as chloroplasts. Inside those chloroplasts is a green pigment called chlorophyll, the source of the 'green' color that plants have. Chlorophyll's job is to soak up sunlight.

C. The Cooking Process:

Once chlorophyll absorbs sunlight, the plant uses that energy to join water and carbon dioxide together. It's like magic!

D. The Food and Leftovers:

After "cooking," the plant gives birth to two things mostly:

- **Glucose:** This is the plant's food! This supplies the energy plant needs to grow.
- **Oxygen:** It's like "scrap" gas that the plant emits into the atmosphere. This is what we breathe, the oxygen.

Interaction 3: Sharing Ideas in Writing

A. Student's Sign Language Gesture: Well, the kid makes a sign for "WRITE" (flat dominant hand on non-dominant flat palm as if writing), then stops and circles their dominant hands around near their head to show: THOUGHT/IDEA, before using two 'V' shapes in both hands and pushing them together with fingers pointing upwards and across from themselves (makes sense?), pulling it apart closer to themselves producing a sign for DIFFICULT.

B. Teacher's Interpretation of the Sign: "The student is trying to write but is having a hard time sharing their ideas."

C. English Question/Answer:

- **Student's Question (implied):** "I have a story idea, but I don't know how to start writing it or how to put my thoughts in good sentences?"
- **Teacher's Response:** "That's a common problem! Especially if you're trying to figure out how to get started, let's use the AI writing prompt generator."

D. How AI Tools Help: The teacher is using an AI writing assistant or prompt generator. The student writes down their central idea (e.g., "a girl who discovers a magical key"). The A.I. then proposes opening lines, potential plot turns or new ways to describe the key. This helps the student push past writer's block and order their ideas.

10. Conclusion

In this Case Study, we showcase how AI technology has brought about a significant transformation in the process of teaching English to Deaf and Hard of Hearing (D/HH) students at Al-Amal Institute. The article explores how innovative AI tools can be harnessed to resolve the specific challenges faced by D/HH students learning to read and write in English to create a more inclusive, fun and personalized experience for these learners. This provides a wealth of information that we view as a window into the adoption and impact of artificial intelligence in this specific educational context, suggesting opportunities for targeted move on but also more general implementations at similar institutions.

Findings The review identified the following key findings regarding potential of AI to support English learning for D/HH Students:

- **Enhanced Reading and Writing Skills** D/HH students solve their writing problems, especially with AI tools that design images since they utilize for them visual imaginations to bring the learning process easier and more interesting.
- **Positive Side of AI** | Students with hearing disabilities and their teachers in Al-Amal Institute see the use of tools for artificial intelligence as a positive development, they are looking into the possibility that it can overcome cases that cause communication barriers and facilitate good learning outcomes.
- **AI Tutors in Classroom** | The addition of AI tutors — most saliently those specifically designed to recognize D/HH culture and learning strategies — can aid D/HH learners throughout online lessons, providing comfort and trust among students using the Internet inside a virtual classroom.
- **Accessibility and Customization** | Bleeding-edge AI advancements lead to powerful tools that do not only make learning environments more inclusive, but have customization capabilities tailored to individuals from new opportunities for smart hearing devices to natural language processing for signed or spoken language.
- The gaps holding the research back include lack of data arising from Deaf-hearing interactions, challenges in processing/superimposing information in real-time (i.e., current algorithms only work about whether a gesture is valid), limited focus beyond gesture recognition and low access to AI methods in less affluent areas as well as worries surrounding algorithmic bias and privacy.

Additionally, AI-generated content can sometimes feel bland and not tailored for unique combinations of D/HH learning styles.

Recommendations

These suggestions are based on what we learned, the study states:

- **Perform Cultural Filtration** | Future AI tools would need to be designed and developed with an understanding of how D/HH people converse in order to communicate appropriately with them as well as having an intimate feel of a human being.
- **AI Tools Integration** | In the near term, it will also in principle be very complementary to integrate with existing learning platforms to augment user experiences and reduce fragmentation across disjointed apps that often compete against each other.

- Emphasis on Equity and Access | The potential of AI technologies should be made available and affordable for all D/HH students, particularly in resource-poor contexts, ensuring all students can receive the benefits these powerful learning tools provide.
- Educator training | All Modi D/HH students implementing AI tools with an extensive strategy in English
- Ethics in Spotlight | Continued research is key to addressing technical challenges such as the small data sets and real time processing. And lastly an ethical question: When we use AI for teaching purposes, we need to do so relatively.

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