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Teaching English Language to Students with Down Syndrome by Using AI Tools in Libya: Case Study Al-Ishraqa School- Hoon

Souad Sanoussi Yosef Jalala *
Department of English Language, Faculty of Education – Waddan, Al-Jufra University, Libya.
*Email: Souadly36@gmail.com

تدريس اللغة الانجليزية لطلاب متلازمة الداون بواسطة استخدام ادوات الذكاء الاصطناعي في ليبيا حالة الدراسة: مدرسة الاشراقة – هون

سعاد السنوسي يوسف جلاله *
قسم اللغة الانجليزية، كلية التربية- ودان، جامعة الجفرة، ليبيا.

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Abstract

Artificial Intelligence (AI) plays a vital role in enhancing English language teaching through innovative methods that promote accessibility and inclusivity. AI-based tools offer a wide range of strategies, techniques, and adaptive resources that can support both teachers and learners by personalizing instruction and facilitating effective communication. In this context, this study emphasizes on the right of students with Down syndrome to learn the English language, given its global significance as a primary means of communication. This study focuses on the role of AI tools in teaching English to students with Down syndrome, particularly during the basic stages of education. It aims to highlight and validate the language learning abilities of these students and to demonstrate that learning English can have a positive and beneficial impact on their educational development rather than a negative one. The study used a descriptive qualitative research method to explore the effect of AI tools in teaching the English language to students with Down syndrome. The questionnaire has used as a tool for gathering data. The results indicate the ability of the students with Down syndrome to learn the English language through visual materials in the classroom. AI tools can play an effective role in this issue. DS students have a strong capacity to manage some jobs in society with successful proficiency. The study recommends the importance of providing a modern educational environment that includes suitable curricula, visual materials, teacher training, and strong encouragement.

Keywords: Down's syndrome, English language, AI tools, teaching, capacity.

الملخص

يلعب الذكاء الاصطناعي دورًا حيويًا في تحسين تدريس اللغة الإنجليزية من خلال أساليب مبتكرة تعزز الوصولية والشمولية. تقدّم الأدوات القائمة على الذكاء الاصطناعي مجموعة واسعة من الاستراتيجيات والتقنيات والموارد التكيفية التي يمكنها دعم كل من المعلّمين والمتعلّمين من خلال تخصيص التعليم وتسهيل التواصل الفعّال. وفي هذا السياق، تؤكد هذه الدراسة على حق الطلاب المصابين بمتلازمة داون في تعلّم اللغة الإنجليزية، بالنظر إلى أهميتها العالمية بوصفها وسيلة أساسية للتواصل. تركّز هذه الدراسة على دور أدوات الذكاء الاصطناعي في تدريس اللغة الإنجليزية للطلاب المصابين بمتلازمة داون، وخاصة خلال المراحل الأساسية من التعليم. تهدف الدراسة إلى تسليط الضوء على قدرات هؤلاء الطلاب في تعلّم اللغة والتحقّق منها، وإثبات أن تعلّم اللغة الإنجليزية يمكن أن يكون له تأثير إيجابي ومفيد على تطوّرهم التعليمي، وليس تأثيرًا سلبيًا. استخدمت الدراسة منهج البحث النوعي الوصفي لاستكشاف تأثير أدوات الذكاء الاصطناعي في تدريس اللغة الإنجليزية للطلاب المصابين بمتلازمة داون. تم استخدام الاستبيان كأداة لجمع البيانات. تشير النتائج إلى قدرة الطلاب المصابين بمتلازمة داون على تعلّم اللغة الإنجليزية من خلال المواد البصرية في الفصول الدراسية. ويمكن لأدوات الذكاء الاصطناعي أن تؤدي دورًا فعّالًا في هذه القضية. يتمتع طلاب متلازمة داون بقدرة قوية على إدارة بعض المهام في المجتمع بكفاءة ناجحة. توصي الدراسة بأهمية توفير بيئة تعليمية حديثة تشمل مناهج مناسبة، ومواد بصرية، وتدريب للمعلّمين، وتشجيعًا قويًا.

الكلمات المفتاحية: متلازمة داون، اللغة الإنجليزية، أدوات الذكاء الاصطناعي، التدريس، القدرة.

1.0 Introduction

The integration of Artificial Intelligence (AI) tools in special education is considered a transformative approach to address the diverse learning needs of students with Down syndrome. Down syndrome is a genetic condition associated with cognitive delays, language impairments, and challenges in memory, attention, and motor skills. Traditional instructional models, which often rely on standardized curricula, may not sufficiently accommodate these learners' individual differences. On the other hand, AI-driven educational technologies offer adaptive, personalized, and inclusive learning environments that enhance educational outcomes for students with Down syndrome.

According to Holmes et al., (2022), one benefit of AI tools exists in their ability to support personalized learning. AI-powered adaptive learning systems can analyze learners' feedbacks in real time and control instructional content, pace, and difficulty accordingly. This individualized instruction is particularly beneficial for students with Down syndrome, who often require repeated exposure to concepts and gradual progression to achieve with mastery. Personalized AI systems help reduce cognitive overload and enable students to learn at their own pace, thereby improving comprehension and recalling.

Jin Ha Woo, Heeyoul Choi (2021) stated that the use of artificial intelligence in education has transformed traditional teaching methods by making learning more flexible and personalized than ever before. AI-based adaptive learning systems have shown strong potential in supporting a wide range of learners, especially students with special needs. Unlike traditional education systems that rely on fixed curricula and often fail to accommodate cognitive, sensory, or movement challenges, AI-powered systems can adapt learning materials to suit each learner's pace, strengths, and areas that need extra support. By using technologies such as machine learning, natural language processing, and neural networks, these systems create

personalized teaching strategies that focus on individual needs. Although still evolving, these technologies aim to improve engagement, enhance learning retention, and promote a more inclusive and equitable educational environment for learners with special needs.

According on Drigas & Ioannidou, (2013), AI tools also play a vital role in the improvement of language and communication skills, which are usually delayed in individuals with Down syndrome. Speech recognition software, text-to-speech tools, and AI-assisted language learning applications present structured opportunities for using vocabulary, pronunciation, and sentence formation. These technologies provide direct feedback and consistent practice, both of which are crucial for supporting expressive and receptive language development

Furthermore, another important benefit of AI in special education is growing learner motivation and engagement. Gamified AI platforms and intelligent tutoring systems provide instant feedback, rewards, and encouragement, which foster positive learning experiences and build learners' confidence. This motivational aspect is particularly important for students with Down syndrome, who may experience frustration or anxiety in traditional classroom settings. The technology platforms and tools can growth the creativity in people with and without disabilities. The great improvement in technologies has enabled Microsoft to empower people with disabilities. For instance, it has provided learning tools that have helped children with disabilities in reading and writing to learn more, Garg, S., & Sharma, S. (2020).

1.1 Problem of Study

Students with Down syndrome face challenges in accessing advanced levels of education within their societies. However, some individuals with Down syndrome have successfully secured meaningful employment in several countries. In general, there is strong focus and care for this population in the training and learning process. Libyan students with Down syndrome still have lack sufficient governmental support. The schools those students attend remain limited and face many difficulties. They try to help their students to get a good level of education, but they still have a lack in some sides, such as helping them to get more skills as learning the English language, getting higher education and technical training. These skills can help them to attend some places and institutions which are dealing with English language. The government schools for Down syndrome don't include English subject in their curriculum. The teachers in these schools also face challenges in teaching English to Down syndrome students. There is a lack of some facilities, such as modern teaching aids and instructional technology. Students with Down syndrome face difficulty engaging in society as equals with their peers. They have less confidence because they have less learning. Moreover, they cannot participate in the labor market particularly in Libyan society. Even though, people with Down syndrome succeed in mastering some jobs, they still face difficulties in some other jobs that require proficiency in using the English language. The English language is considered a basic requirement for most jobs.

1.2 Questions of the study

1. Do Down syndrome students have capacity to learn English language?
2. Can AI tools be effective in teaching English language to students with Down syndrome?
3. Do students with Down syndrome need to learn English language?

1.3 Signification of the Study

This group of society has the right to learn like the others. There is no doubt that English has a great importance in international communication, which gives more attention to using technology and globalization. Students with Down syndrome need to communicate with others in different ways. For this reason, teaching English should exist in learning for students with

Down syndrome particularly, in the basic education stages of learning English as a foreign language.

Down syndrome syllabus designers are more interested in this study. They should pay attention to the fast improvement in teaching English by using modern methods and techniques, such as using AI tools. Recently, there has been a strong focus on this population of society. Children with Down syndrome became a center of the educators' and psychologists' argument. Educational schools and centers for Down syndrome are spread around the world in general and in Libya in particular. This study is helpful for teachers, students, inspectors and designers as a whole. To engage people with Down syndrome in their society, they should be able to get benefits from all the institutions.

Moreover, the influence of English on students with Down syndrome is positive rather than negative. Even though they have disability in pronunciation, they have the capacity and mental process to be aware of some issues. For instance, they can hold the meaning of some photos, guiding marks in public/government places, using some technological applications,…etc.

1.4 Aims of Study

This study aims to;

1- Highlight on the capacity of student with Down syndrome to learn English as a foreign language.

2- Helping Down syndrome students to overcome challenges that face to learn the English language by using AI tools.

3- Pay attention to the crucial role of AI tools in developing the education of this category.

4- Motivating and encouraging students with Down syndrome to learn English.

Literature review

2.1 **Second Language Acquisition, Bilingualism, and Educational Technology for Children with Down Syndrome**

Currently, it is generally anticipated that children will acquire proficiency in two or more languages. They may begin to learn more than one language before starting formal education programs, while others do not get this experience until they start school. Buckley (2002) stated that many children will be spoken to only one language at home, while the second language may be used individually in the community or solely within educational settings. This raises questions among educators and parents regarding whether children with Down syndrome should participate in second language acquisition efforts.

In addition to Buckley (2002), in comparison with common developing bilingual children at the same level of language development, the bilingual children with Down syndrome were making the same progress in vocabulary in both languages. Children with Down syndrome, regardless of bilingual or monolingual status, use shorter phrases and sentences compared to their typically developing peers. This observation reflects the characteristic delay in acquiring early grammatical structures commonly observed in children with Down syndrome.

Linsenmayer et al, (2025) reported that integration of technology in education programs has reflected the potential to support students with special education needs in the learning process. Using technology can help individuals with SEN to overcome their barriers to learning and participate fully in society. Technology provides strong support to students with special needs and it is widely recognized, Good (2021).

2.2 Bilingual Development and Individual Differences in Children with Down Syndrome

According to Wiley (2016), bilingual children constitute a diverse population whose experiences vary considerably in the timing and context of language acquisition, as well as in

the development of literacy skills in each language. While it is commonly acknowledged that all children demonstrate unique developmental systems, children with Down syndrome exhibit distinct learning patterns. Specifically, they tend to show a greater variety of cognitive functioning, language acquisition, and gradual development that illustrates how they engage with and acquire one or more languages.

2.3 Technology in Special Education

Based on UNESCO (2023); Al-Azawei et al, (2016), and Ok et al., (2018), technology has become an essential component of modern special education by providing innovative instructional approaches that address the diverse learning needs of students with disabilities. Digital technologies in multiple types, such as computers, tablets, mobile applications, interactive whiteboards, virtual learning environments, and assistive software, have shifted traditional educational practices into more personalized and accessible learning experiences. These technologies support differentiated instruction by enabling educators to adapt teaching materials according to learners' cognitive, sensory, and physical abilities. Research has showed that technology improves student engagement, motivation, communication, and academic achievement while reinforcing independence and self-adjusted learning. Moreover, technology contributes to inclusive education by decreasing barriers to participation and facilitating equal access to educational opportunities. The increasing integration of intelligent educational technologies has also enabled teachers to monitor learners' progress, provide immediate feedback, and design individualized intervention programs that improve educational outcomes for students with special educational needs.

2.4. Assistive Technology for Learners with Down Syndrome

Krasniqi et al, (2022), White et al, (2023), Neil & Jones (2018) stated that assistive technology plays an important role in supporting the educational, communicative, and social development of learners with Down syndrome. These learners encounter many difficulties in expressive language, working memory, and speech intelligibility. Assistive technologies provide equal means of accessing information and articulate ideas. Common assistive tools include augmentative and alternative communication (AAC) systems, speech-generating devices, touchscreen tablets, educational applications, and multimedia learning platforms. These technologies are effective in facilitating language development by providing visual supports, interactive instructional activities, and opportunities for practice in meaningful contexts. Research indicates that assistive technology not only improves communication and literacy skills but also builds learner confidence, independence, and participation in both classroom and community settings. Recent systematic reviews also emphasize that incorporating assistive technology within individualized educational programs contributes significantly to academic achievement and social inclusion for individuals with Down syndrome.

2.5 Artificial Intelligence Applications for Individuals with Down Syndrome

Artificial intelligence (AI) has been increasingly recognized as a transformative technology in special education for its ability to direct personalized, adaptive, and data-driven learning experiences. For students with Down syndrome, AI-powered technologies have provided convenient solutions that address challenges related to communication, language acquisition, cognitive improvement, and independent living. Machine learning algorithms, natural language processing, speech recognition, computer vision, and intelligent teaching systems can analyze learners' individual performance and immediately adapt instructional content to meet their specific needs. AI applications also support speech therapy through real-time pronunciation feedback, facilitate communication using intelligent augmentative and

alternative communication (AAC) systems, and adjust learner progress through predictive analytics. The remarkable innovation is AI-assisted communication software capable of translating indefinable speech into understandable language, therefore enhancing social interaction and educational participation. Although the achievement of AI for students or individuals with Down syndrome remains an emerging field, present evidence indicates that these technologies have considerable potential to enhance communication skills, academic achievement, learner independence, and quality of life. However, researchers emphasize the significance of ensuring ethical implementation, teacher training, data privacy, and impartial access to AI technologies to increase their educational benefits Costanzo et al, (2023); Krasniqi et al, (2022), Holmes et al, (2022).

2.6 The Role of Artificial Intelligence in Enhancing Communication Skills among Individuals with Down Syndrome

Abbeduto et al., (2007) reported that artificial intelligence (AI) has become known as a transformative technology in education and healthcare, providing innovative solutions to enhance communication skills among individuals with Down syndrome (DS). Communication is one of the primary developmental challenges experienced by individuals with DS because of delays in speech production, limited expressive language, limited verbal working memory, and difficulties with utterance and phonological processing. These communication difficulties often impact academic achievement, social participation, and independent living. Consequently, researchers and educators have increasingly discovered AI-driven technologies to provide personalized interventions that introduce the variety of communication needs to this population.

Moreover, one of the most important advantages of AI tools is their capacity to shift individualized learning experiences. In comparison with traditional educational approaches, AI-powered systems continuously analyze learners' performance and adapt instructional content based on their abilities, learning proficiency, and communication needs. Through machine learning algorithms, intelligent tutoring systems can specify learners' strengths and weaknesses and automatically adapt activities to maximize learning results. Such adaptive instruction is specifically beneficial for students with Down syndrome because their language improvement differs considerably across individuals and often requires continuous adjustments to instructional strategies (Holmes et al., 2022).

Recent advances in natural language processing (NLP) and speech recognition technologies have significantly expanded opportunities for enhancing communication skills among students with Down syndrome. Speech recognition systems are able to analyze pronunciation patterns, determine articulation errors, and provide direct corrective feedback through language-learning activities. This real-time response enables learners to practice speech repeatedly in supportive environments, thereby developing speech and expressive language skills. In equivalent, conversational AI applications, including intelligent virtual assistants and AI chatbots, create exchange communication environments that stimulate learners to engage in authentic conversations while receiving personalized linguistic support. These tools can reduce communication confusion and increase learners' confidence by enabling them to practice language without fear of negative evaluation, Costanzo et al., (2023); Holmes et al., (2022).

Artificial intelligence has also enhanced augmentative and alternative communication (AAC) technologies, which are commonly used to support individuals with complex communication needs. Traditional AAC systems primarily depend on fixed symbols and pre-programmed vocabulary; however, AI-enhanced AAC systems utilize predictive language

models and machine learning algorithms to create contextually convenient vocabulary and personalized communication suggestions. These intelligent systems save communication effort, increase the speed of message construction, and enhance conversational efficiency. For instance, *Talkitt* as AI tool is an AI-based communication system that is designed to translate unintelligible speech into understandable language, facilitating communication between individuals with speech impairments and their communication peers as well. AI-assisted AAC technologies demonstrate considerable potential for improving communication effectiveness and promoting greater social inclusion among individuals with Down syndrome, Costanzo et al. (2023).

2.5 Communication Strategies for Learners with Down Syndrome in the Classroom

Kumin, (2001) documented that the classroom plays an essential role in establishing the communication development of students with Down syndrome by providing structured opportunities for meaningful social interaction and language use. Teachers should implement evidence-based communication strategies that meet the cognitive and linguistic requirements of classroom participation while creating enjoyable and supportive learning experiences. Such strategies involve the use of visual supports, simplified language, modeling, collaborative learning activities, peer-assisted instruction, role-playing, and positive reinforcement. These instructional strategies stimulate students with Down syndrome to share actively in classroom discussions, collaborate with peers, and improve both expressive and receptive language skills. Creating a convenient classroom environment where communication is appreciated and supported enables students to build confidence and become more independent communicators.

One of the initial educational targets for students with Down syndrome is to improve functional communication skills that help them to interact effectively with teachers and classmates. Parents and educators generally believe these learners can communicate their needs, express their feelings and ideas, ask for help when necessary, establish friendships with peers, participate in classroom discussions and collaborative activities, and gradually enhance the confidence to give presentations and contribute to group learning experiences. Achieving these objectives requires continuous collaboration between teachers, speech-language therapists, and families to provide consistent communication opportunities across educational and home settings.

In addition by Kumin, (2001), significant primary goal in classroom instruction is to encourage spontaneous communication rather than depending only on prompted or rehearsed responses. However, improving spontaneous speech may take a long time because many learners with Down syndrome experience delays in expressive language, verbal working memory, and speech production. They often need extra time to adapt to new classroom routines, unfamiliar learning activities, and changes in their environment. Consequently, educators should establish predictable classroom routines, provide sufficient opportunities for communication, and generate low-anxiety learning environments that stimulate students to participate without fear of committing mistakes. Students with Down syndrome may initially appear quiet or refuse to communicate in group settings, particularly when they lack confidence in their speech intelligibility or language abilities. This reluctance should not be considered as a lack of interest or motivation but rather as a reflection of their communication challenges. Teachers can address these challenges by allowing additional response time, encouraging peer support, acknowledging all communication attempts positively, and highlighting successful interaction over linguistic accuracy. Such supportive instructional practices build self-confidence, promote classroom participation, and reinforce the gradual development of effective communication skills.

2.6 The importance of language to Down syndrome individuals

This difficulty in teaching children with Down syndrome to speak enough has many serious consequences for the children's development from the end of the first year of life. Learning to talk enables a child to communicate in more effective and complex ways, to gain ever-increasing amounts of information about the world and to use language for mental processes such as thinking and remembering. Sue Buckley (1993).

The study that has done by Elena .A (2025) the results indicate an improvement in word identification skills (emergent literacy) and word recognition without relying on phonological processing. This progress can be attributed to the implementation of the global reading approach as the selected teaching method. The effectiveness of this method is associated with the strengths of children with Down syndrome (DS) in mechanical and short-term memory, rather than in phonological processing, an area in which they may experience difficulties. The instructional materials developed for the program incorporated familiar words at both the reading and writing levels, enabling children in the experimental group to perform more effectively. Furthermore, the enhancement in skills and performance was reflected in intellectual development indicators, particularly in the intelligence quotient (IQ). Noticeable improvements were observed at the individual level across most of the analyzed participants, thereby confirming the positive impact of speech therapy intervention through the multimodal program on cognitive performance.

2.8 Language to Communicate for Down syndrome

Hartwell at el (2025) inserted that within general views, every child's journey is unique. Their development isn't set in stone; rather, it's shaped by a complex mix of life experiences and surroundings. On a day-to-day level, things like how a family communicates, whether a child feels included at school, and their overall physical health all play an essential role in how they grow (Guralnick 2017).

Actually, these "environmental" factors don't exist in emptiness. They are often related to the resources a family has—things like the parents' own mental well-being, the time they can dedicate, their financial situation, and whether they can access therapy or a hard support network (Guralnick 2017). These external influences might actually carry more weight for children with Down syndrome than for typically developing kids (Abbeduto et al. 2016). This makes early intervention a real game-changer, as it provides the best foundation for building social confidence and cognitive skills Guralnick (2017).

3.0 Methodology

3.1 Participants

This study describes the procedures that were used to investigate in the impact of using AI tools in teaching the English language to the students with Down syndrome. The study was conducted in "Al-Ishraqh schools" through six teachers who teach thirty-eight students with Down syndrome in different grades.

3.2 Instruments and Data Collection

Quantitative methods were used in this study, which depended on a questionnaire for gathering data. The questionnaire was distributed to six teachers with different experience in teaching students with Down syndrome.

The questionnaire consists of three sections. The first section includes demographic data (Age, gender and experience), while the second section is designed for direct questions around the main issue of the study. This section consisted of 21 statements designed to investigate teachers' perceptions regarding the education of students with Down syndrome and the potential role of

technology and artificial intelligence (AI) in supporting their learning. The third section was an open question to give teachers more freedom to add any important information if they have.

3.3 Data Analysis Methods

The tool used for gathering data for this study was the questionnaire. Six teachers participated in answering the questionnaire. (IBM) SPSS (Statistical Package for Social Sciences) version 26 software was used to analyze the frequencies and percentages of the teachers' responses about the topic.

4.0 Results

The main target of this study is to investigate in the influence of using AI tools in teaching the English language to students with Down syndrome.

Section (A)

This section shows the distribution of demographic date that includes the gender, age qualification and experience of the teachers in Al-Ishraqa school.

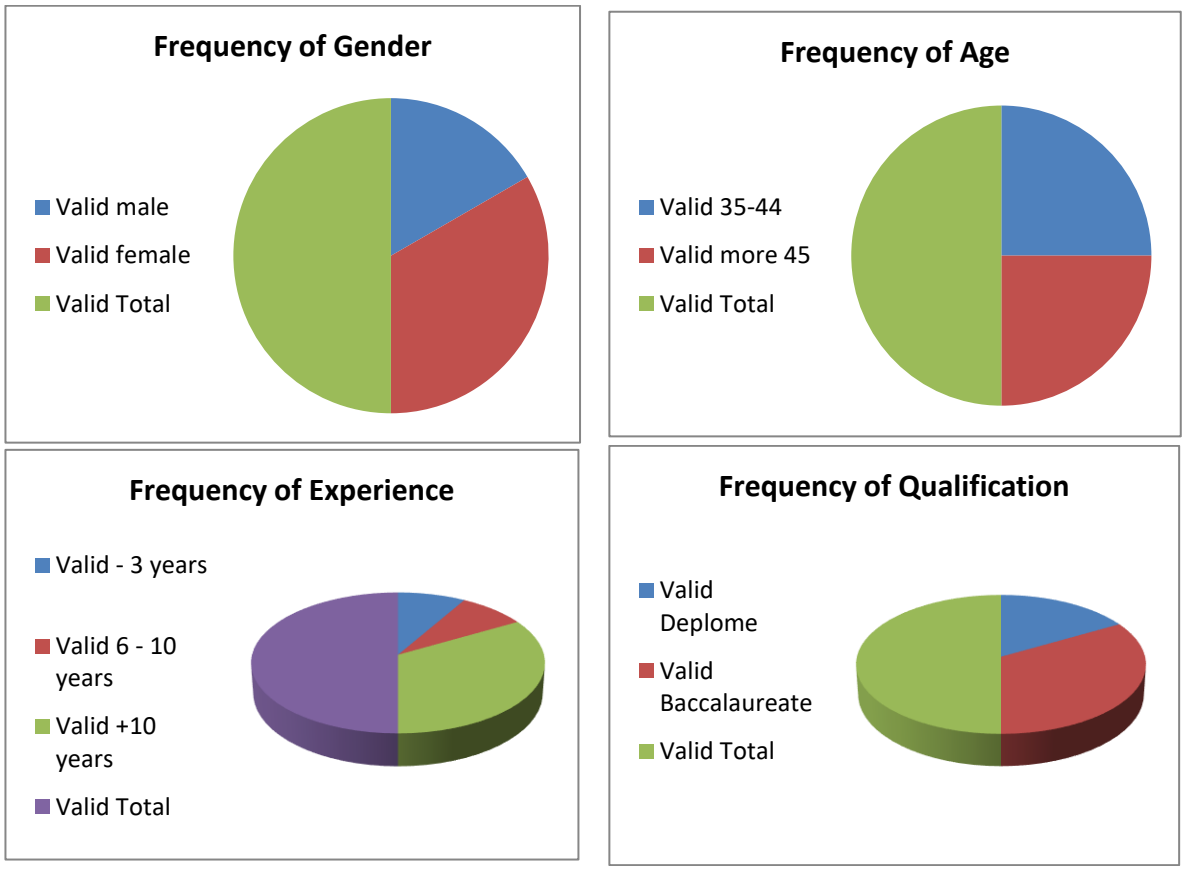

Figure 1. Distribution of Teachers' Demographic Characteristics Including Gender, Age, Academic Qualification, and Teaching Experience at Al-Ishraqa School

Section (B)

This section clarifies the teachers' responses to twenty-one questions that are designed to investigate the influence of AI tools in teaching English to students with Down syndrome and their ability to lean English at an acceptable level.

Table 1. Descriptive Analysis of Teachers' Perceptions Toward the Role of AI Tools in Teaching English to Students with Down Syndrome

Num.	Question	Agree	Neural	Disagree	Range	Mean	Std. Deviation
Q1	Students with Down syndrome are able to comprehend academic material well.	4	1	1	2.00	2.5000	.83666
Q2	Teaching students with Down syndrome requires specialized instructional strategies.	4	2		1.00	1.3333	.51640
Q3	Students face challenges in communication and attention.	5		1	4.00	2.3333	1.36626
Q4	There is a lack of appropriate educational materials.	6			1.00	1.5000	.54772
Q5	I use technology when teaching students with Down syndrome.	5		1	4.00	1.8333	1.60208
Q6	Students with Down syndrome use smartphones effectively.	3	1	2	4.00	3.0000	1.67332
Q7	I have received training in the field of education and special education.	3	2	1	3.00	2.8333	1.16905
Q8	Students with Down syndrome respond better to visual learning.	6			1.00	1.3333	.51640
Q9	Individualized education contributes to improved learning outcomes.	6			.00	1.0000	.00000
Q10	I prefer using technology when teaching students with Down syndrome.	5	1		2.00	1.8333	.75277
Q11	Technology helps improve students' communication skills.	6			1.00	1.3333	.51640
Q12	Artificial intelligence tools can support the education of students with Down syndrome.	6			1.00	1.6667	.51640
Q13	Teachers need further professional training in special education.	6			.00	1.0000	.00000

Q14	Teachers need more institutional support.	6			.00	1.0000	.00000
Q15	Students with Down syndrome are able to perceive the relationship between word and image.	6			1.00	1.8333	.40825
Q16	Students with Down syndrome are able to use artificial intelligence tools to communicate in English.	2	1	3	3.00	3.6667	1.50555
Q17	Students with Down syndrome are more engaged with visual lessons.	6			1.00	1.1667	.40825
Q18	Students with Down syndrome can succeed in various jobs.	5		1	3.00	1.6667	1.21106
Q19	Artificial intelligence applications can help individuals with Down syndrome master their job functions.	6			1.00	1.6667	.51640
Q20	The use of artificial intelligence tools can increase the motivation of students with Down syndrome in the learning process.	5	1		2.00	1.5000	.83666
Q21	Students with Down syndrome can be integrated into mainstream public schools.	4	2		2.00	2.1667	.75277

Based on the results that appear in the table above, the responses indicate an overall positive attitude toward inclusive education, technology integration, and the need for professional development. The findings reveal that participants strongly believe that students with Down syndrome require specialized instructional strategies, as in Q2. Participants overwhelmingly agreed on the ability of students with DS to interact with visual lessons and tools in Q17. They can use technology at a good level as well. All the teachers believe that artificial intelligence applications can help DS students master their jobs, as shown in Q19. The teachers' responses on Q15 reflect the ability of students with Down syndrome to perceive the relationship between the word and the image. The teachers believe the use of artificial intelligence tools can increase the motivation of students with Down syndrome in the learning process. Regarding technology use, most participants indicated that they currently use technology when teaching students with Down syndrome (Q5).

In contrast, all participants agreed that students with Down syndrome face challenges in communication and attention (Q3). DS students and their teachers face some challenges such as the lack of appropriate educational materials, good training and institutional supporting as in Q4, Q13 Q14. This finding highlights an important obstacle that may hinder effective instruction and emphasizes the need for the development of specialized educational resources. Students with Down syndrome also face challenges in comprehending academic material as well. The results indicate a division among teachers around the students' ability to communicate in English, while they are totally in agreement on their ability if the students use artificial intelligence tools to communicate in English.

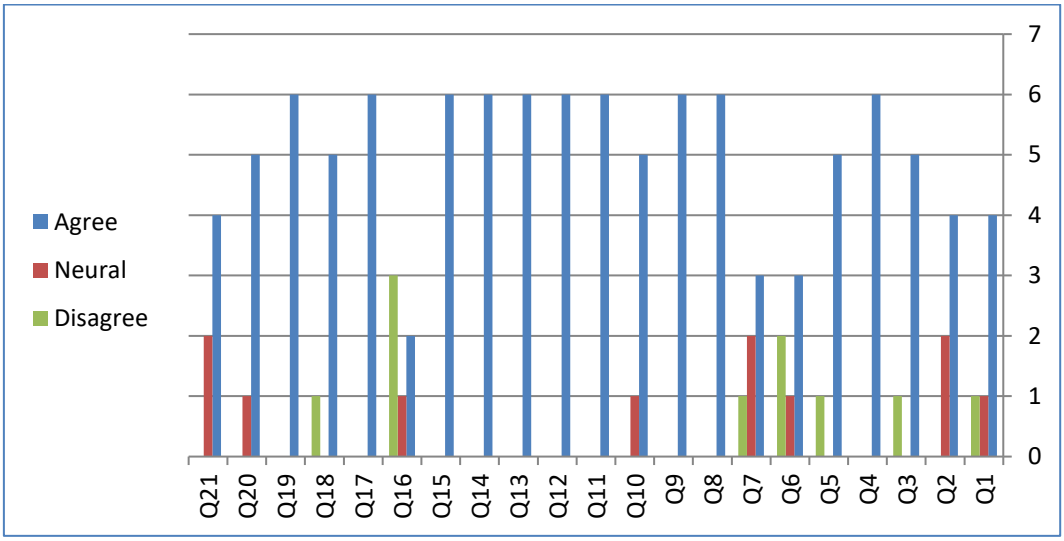

Figure 2. Teachers' Responses to the Questionnaire Items (Q1–Q21) Regarding AI Tools in Teaching English to Students with Down Syndrome

Section (C)

This section was designed open question to give participate more freedom to add any comments or additions around the topic. The teachers claimed the necessity of incorporating students with simple disabilities in public schools and giving them the opportunity to play an important role in society. Some teachers emphasized on necessity of directing DS students into technical education field to improve their mental and manual skills as an advanced step enter into the labor market.

4.2Discussion

This study explored teachers' perspectives on teaching students with Down syndrome and the potential role of technology and artificial intelligence (AI) in supporting English language learning. Overall, the results indicate a positive attitude toward inclusive educational practices, technology integration, and AI applications as a supportive instructional tool. The findings reveal consensus among the Participants on the positive role of integrating AI tools to improve their teaching methods. The results indicate to the possibility of teaching the English language to students with Down syndrome similar to healthy students. The findings provide strong evidence on the ability of DS students to learn the English language by modern visual teaching methods. The Participants support using AI tools to teach these students the English language effectively.

According to the findings, students with Down syndrome can overcome their disability through a suitable academic environment. With existing teachers with high qualifications and proficient training in using AI tools, DS students can engage in society and achieve a variety of jobs. They can communicate in English by using AI tools at least at a good level. These outcomes suggest that while educators acknowledge the potential of AI and digital technologies, successful implementation requires adequate teacher preparation, appropriate educational resources, and continuous institutional support. Educators can adapt AI tools to address the challenges that they face and overcome the difficulties in the learning process.

In the labor market, most jobs depend on using technology and AI applications. Based on the results, DS students can use technology at an acceptable level that enables them to get their rights in society by learning English terms, vocabulary, sentences and expressions that are required. DS students interact with visual materials, with the ability to recognize the relationship between the picture and its meaning which is considered the main key in modern English teaching methods.

4.3 Conclusion:

In general, the study concludes that artificial intelligence has a significant role in improving English language learning for students with Down syndrome by providing personalized, interactive, and visually supported learning experiences. Nevertheless, realizing these benefits requires investment in teacher training, the development of accessible instructional materials, and supportive educational policies that promote inclusive and technology-enhanced learning environments.

The findings contribute to the expanding literature on inclusive education by highlighting both the opportunities and challenges associated with integrating AI into special education. Based on the results, this study recommends the necessity of designing syllabi that are more suitable and effective in teaching DS students. To follow the advancement of using technology and artificial intelligence in private learning, government institutions should support personalized learning by providing a helpful, interactive educational environment.

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Appendix

Questionnaire

This questionnaire aims to explore teachers' experiences, challenges, and strategies when teaching students with Down syndrome, with special attention to the use of technology and AI tools in education.

****Instructions****

Please answer all questions honestly. Your responses will be used for academic research purposes only.

Section 1: Demographic Information

1. Gender

☐ Male ☐ Female

2. Age

☐ Under 25 ☐ 25–34 ☐ 35–44 ☐ 45+

3. Academic qualification

☐ Diploma ☐ Bachelor's degree ☐ Master's degree ☐ PhD

4. Years of teaching experience

☐ Less than 3 years ☐ 3–5 years ☐ 6–10 years ☐ More than 10 years

Section B

Num	Question	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1.	Students with Down syndrome can effectively learn academic subjects.					
2.	Teaching students with Down syndrome requires specialized teaching strategies.					
3.	The students face challenges in communication and attention.					
4.	There is a lack in teaching materials.					

5.	I use technology when teaching students with Down syndrome					
6.	Students with Down syndrome use smart phone effectively.					
7.	I have received training in special education.					
8.	Students with Down syndrome respond better to visual learning.					
9.	Individualized instruction improves learning outcomes.					
10.	I prefer to use technology when teaching students with Down syndrome					
11.	Technology helps improve students' communication skills.					
12.	AI tools can support teaching students with Down syndrome.					
13.	Teachers need more professional training in special education.					
14.	Teachers need more institutional support					
15.	Students with Down syndrome can aware the relationship between the word and the picture.					
16.	Students with Down syndrome can use AI tools to communicate in English language.					
17.	Students with Down syndrome are more active with visual lessons.					
18.	Students with Down syndrome can success in many jobs					
19.	AI applications can help DS to master their jobs.					
20.	Using AI tools can rise the motivation of DSS in learning process					

Section 'C'

Do you have any recommendations?

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Thanks for participation

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare that they have no conflict of interest.