

The effect of a teaching program based on cloud computing in developing writing skills among autistic students

Mohamad Ahmad Saleem Khasawneh^{a*}

^aAssistant Professor, Special Education Department, King Khalid University, Saudi Arabia

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ABSTRACT

The main objective of this study was to examine the effectiveness of a teaching program utilizing cloud computing in enhancing the writing skills of students with autism. The research comprised a group of kids diagnosed with ASD who attended schools situated in the Al-Mafraq Governorate. The initial intention was for the experiment to last for a duration of 30 days. A total of 30 students were included in the study, with 15 students randomly assigned to the experimental group and the remaining 15 students assigned to the control group. Following the implementation of the intervention, the experimental group demonstrated a higher level of performance on assessments measuring language and content abilities compared to the control group. There were no significant differences seen in the writing proficiency scores of the experimental group, both at the follow-up assessment and immediately after the intervention.

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1. Introduction

The contemporary period is seeing significant and swift advancements in technology, including the utilization of computer tools and the Internet in numerous facets of human existence. Due to its significant advantages in facilitating communication and disseminating valuable information, humans have increasingly embraced a confined world that both impacts and is impacted by them. This environment has also fostered a sense of collaboration across many domains of human, natural, and applied sciences. The elimination of spatial and temporal limitations has facilitated the exchange of knowledge and experiences among individuals. This is largely due to the ongoing advancements in information and communications technology, as well as the widespread integration of technological innovations in various aspects of life, such as the economy, politics, and society. Consequently, the use of these technologies has become an essential and indispensable method of communication and interaction for individuals and all types of societal institutions.

The field of education has been greatly impacted and shaped by the integration of technology into the learning process. Educational theories and trends have emphasized the use of technology, such as visual and audio aids, to facilitate communication between teachers and students. Additionally, there is a focus on creating a conducive moral and material educational environment, encompassing ideas, methods, tools, and management. The provision of technological educational methods, such as laboratories, computers, and electronic networks, to schools and institutions in accordance with the educational technology system has enhanced research skills and awareness of advancements in the educational and technical domains.

Digital technologies play a crucial role in the success of the educational process, including the utilization of cloud computing technology. This technology relies on the Internet to access programs and information stored on a remote server known as the "cloud." The system comprises a vast network of interconnected computers that can be accessed via the Internet. This may be done using a web-based service like Google Drive, SkyDrive, Gmail, or Office 365.

* Corresponding author.

E-mail address mkhasawneh@kku.edu.sa (M. A. S. Khasawneh)

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Cloud computing technology offers significant prospects for enhancing educational systems and teaching methodologies. It enables the implementation of optimal approaches and models that facilitate the delivery of educational experiences to students. These approaches are rooted in scientific and logical principles, emphasizing the active engagement of learners, fostering motivation, and enhancing critical thinking and linguistic abilities. Particularly, proficiency in the English language. Due to the widespread usage of the English language, it has become crucial to acquire proficiency in reading and writing it. The acquisition of language enables individuals to effectively communicate and integrate into different societies. One of the primary objectives of teaching language is to facilitate the individual's engagement in various life activities, serving as a means of oral and written communication between different groups of people. Additionally, language proficiency serves as a tool for reading a wide range of books on various subjects.

Acquiring proficiency in the English language can be a challenging process. English language learners require extensive linguistic support and a diverse range of language experiences, including auditory, written, reading, and spoken activities. Furthermore, schooling focused on all facets of the language, encompassing both Arabic and English. English is crucial for facilitating communication and fostering mutual comprehension among individuals within a culture and across other societies.

Writing skills are one of the fundamental abilities required for mastering the English language. Numerous studies have demonstrated that a significant number of student's encounter obstacles and difficulties in acquiring proficient writing skills, despite the crucial role writing plays in communication, performance, academic achievement, and overall success. These challenges may arise from inadequate preparation of students throughout their educational journey or deficiencies in the curriculum. Academic disciplines and education, in general, provide challenges for students who are learning them as a second language. They must have a specific level of consciousness regarding the acquisition of the English language, including knowledge of vocabulary, the utilization of accurate words and phrases, and the art of rhetoric. The purpose of this is to effectively communicate with the reader, as writing skills are intricate linguistic abilities that need a series of instructional methods and preparations.

Writing and acquiring talents are often regarded as one of the most significant abilities bestowed on humans. Writing requires the capacity to produce ideas and communicate them effectively while considering sentence structure, grammar, and coherence in the topic. Acquiring writing skills necessitates real-life situations where students engage with their peers in a live environment characterized by dialogue. This environment encourages the expression of opinions, taking positions, and making judgments. The social constructivist theory, influenced by the ideas of Russian scientist Vygotsky (1978), emphasizes the importance of dynamic interaction between the learners. The instructor depends on the scaffold to carry out new activities, within a collaborative social setting. According to Vygotsky's theory, knowledge is primarily constructed through a cooperative social process involving the student, teacher, and other students. The teacher guides the students' thinking and helps them form meaning. Therefore, the learner autonomously and distinctly builds their knowledge. Thus, the classroom is the most suitable environment for this technique, thereby necessitating the initiation of such an active contact.

Writing skills are a fundamental aspect of language proficiency that significantly impacts the growth of other linguistic abilities, including reading, speaking, and listening, and are intricately interconnected with them. Research has shown some inadequacies among students in their proficiency in writing abilities, which subsequently resulted in a decrease in their academic performance when it comes to completing written assignments and themes. Research has also verified that both students in general and students with autism specifically must enhance their writing proficiency and cultivate their expertise in diverse subject areas and writing styles, utilizing the most up-to-date technological approaches accessible to them. This will enable them to excel in distinct contexts and real-life scenarios, enabling them to select suitable texts that ignite their motivation and fulfill their sense of competence. This study aimed to investigate the impact of cloud computing-based education software on the development of writing abilities in English among students with autism.

1.1 Research questions

The objective of this research is to examine the given questions based on the prior conversation.

- 1- Are there statistically significant variations in the effectiveness of teaching programs based on cloud computing in developing writing skills among autistic students between the experimental and control groups?
- 2- Are there significant variations in the effectiveness of teaching programs based on cloud computing in developing writing skills among autistic students in the experimental group?
- 3- Is there a statistically significant difference in scores between post-test and follow-up tests when assessing the effectiveness of teaching programs based on cloud computing in developing writing skills among autistic students?

2. Literature review

Cloud computing is the practice of utilizing shared resources over the Internet, with costs dependent on the amount of usage. This technology was developed to address the issue of expensive technical resources and enhance resource management for enterprises, particularly after the deployment of internet infrastructure in many worldwide locations (Samyan & St Flour, 2021). Laptop computers and smartphones have greatly enhanced communication by providing Internet access and facilitating the exchange of various information and files. Virtualization technology enhances the efficiency of computer resources and

enhances their adaptability based on workload and consumption levels. The expenses associated with owning an item, including maintenance and enhancements, are assumed by an external entity known as the service provider (Tajur, 2022). Educational institutions have used this technology to minimize technical and informational expenses, while enhancing the effectiveness of human labor in carrying out their duties inside these institutions. The efficiency and efficacy of institutions rely on their administrative performance, which enables them to achieve their objectives (AL-Omari, 2021). The key objective today is to enhance administrative performance. These institutions prioritize streamlining their work procedures to achieve maximum efficiency and effectiveness, while reducing time and expenses to ensure their success and uniqueness (Al-Muraikhi, 2023).

Cloud computing is a frequently utilized and vague term in contemporary society. It refers to the services, apps, software, hardware, and resources that may be accessed over the Internet and are controlled by a third-party service provider at their data centers. An individual who voices discontentment with certain aspects of this system is commonly referred to as a detractor in the pay-per-use model (Ismael & Mubariz, 2020). Many companies frequently employ this strategy, which necessitates payment in order to access and utilize cloud computing services. Compensation is determined based on the consumption of processing capabilities, storage space, memory capacity, and the number of authorized users, among other factors. Instead of using your computer for network connections and storing apps and files, these resources are stored in data centers known as the cloud (ALharahsheh & Al-Dhiabat, 2019). The computer functions as a tool for accessing and establishing a connection with the cloud. This applies to all computers within a corporation. Instead of promptly installing the software they are building on employees' devices. The applications are deployed on the cloud and operate in a conventional manner (Baldassarre et al., 2018).

According to Qasem et al. (2019), the National Institute of Standards and Technology characterizes it as a structure that allows for dependable and effortless network connectivity, thereby streamlining the process of acquiring and activating diverse computing resources with minimal service provider involvement or administrative exertion. The cloud architecture comprises five fundamental characteristics, three service delivery approaches, and four implementation frameworks are discussed. This technological innovation operates through the utilization of computer storage resources, processing capabilities, and Internet connectivity. It is offered as a service by Internet service providers (Komalasari et al., 2020). In order for cloud computing technology to function, the following elements must be present:

- User or beneficiary: The recipient of this technology will access and utilize its services via an Internet-connected computer or mobile device.
- Applications: The recipient is granted access to an extensive range of cloud-based application programs, encompassing services such as word processing, presentation, spreadsheet, and information sharing (Alashhab et al., 2020).
- Platforms: This service is offered by Apple and Google, which provide large-capacity servers with swift data processing capabilities and ample storage (Ali et al., 2018).
- Infrastructure: The provision of services is heavily reliant on the cloud infrastructure, which comprises data storage facilities, personal computers, and the Internet (Ali, 2019).
- Services: Applications furnish users with a multitude of functionalities that can be employed when their device is linked to the Internet. In addition to messaging and text editing, the services offered include email, calendar, and text editing (Alonso-Monsalve et al., 2018).

A unique collection of functionalities distinguishes cloud computing, which includes self-service. This concerns the ability of individuals to independently utilize and access cloud-based applications according to their specific requirements. Using a web browser, users are able to manipulate and store data in the cloud infrastructure (Arpaci, 2019). The ability to transition between service providers without encountering significant adverse consequences is flexibility. Furthermore, the notion encompasses the ability to seamlessly integrate diverse services, such as acquiring storage from one provider and utilizing software from another, in accordance with the dependability and effectiveness of each service provider (Elhoseny et al., 2018). Also encompassing flexibility is the capacity to expand and adapt to impending changes through the utilization of the most recent iterations of cloud-based software and hardware. Users can access the services of cloud computing through a web browser, irrespective of the operating system, access device, or geographical location in relation to the cloud. Cost minimization: Utilizing computers obviates the necessity of procuring server space, software, storage devices, and hardware maintenance. The responsibilities are executed in a remote capacity by the service provider using a personal computer, desktop computer, or mobile phone connected to the internet. The prioritization of usability is a characteristic that modern communication methods via Internet-connected digital devices augment in cloud computing services. This facilitates effortless data storage and retrieval from any location, in addition to promoting seamless collaboration and sharing among users (Juma & Tjahyanto, 2019).

A multitude of corporations offer cloud computing services to end users, with Microsoft, Amazon, and Google holding the most notable positions. This presentation will elucidate the notable services rendered by Google, which are conveniently accessible and cost-free. Email, Google Drive, Google Docs, Google Sites, OneDrive, Google Presentations, Google Forms, Google Calendar, and Google Meet are among the most important services offered (Njenga et al., 2019). Media students have access to a variety of services to support their academic and professional endeavors, including research applications, educational tools, and academic resources. The necessity for exclusive device utilization (e.g., computer or mobile), physical location, or time constraints is omitted (Aydin, 2021). Cloud computing has garnered significant interest from information sector professionals. This is since it enables educational institutions to receive infrastructure, services, and programs via a network,

which provides numerous benefits (Al-Muraikhi, 2023). Cloud computing empowers administration to create and utilize a wide variety of content, such as documents, tables, images, presentations, and interactive video displays. Educational institutions have come to rely heavily on cloud computing due to its capacity to store audio recordings without requiring a substantial quantity of storage space (Al-Adwan, 2023). Utilizing cloud computing resources in education improves learning and fosters innovation among both individuals and groups, according to several studies. Additionally, it aids in the resolution of academic challenges (AL-Safasfeh & Al-Ajlouni, 2019). While cloud computing does have a few minor disadvantages, these are negligible in comparison to the immense capabilities offered by the cloud environment. Furthermore, the cloud maintains stringent security protocols that are impervious to even the tiniest of errors. This underscores the inherent security features of the cloud computing environment (Ismael & Mubariz, 2020).

According to Tajur (2022), the utilization of cloud technologies to deliver learning functionalities not only aligns with the behavioral learning model, but also enhances the learning experience in social contexts. Applications based on cloud computing facilitate collaboration and communication through their tools and functions, allowing students to engage in collaborative learning activities and exchange information.

The development of language and speech is characterized by a sequence of interrelated stages that are impacted by various factors including age, intelligence quotient (IQ), and social, physical, and motor maturation (Tran & Weiss, 2018). Consequently, unlike their neurotypical peers, autistic children do not acquire linguistic abilities in the same way. Quite often, children diagnosed with ASD exhibit the ability to imitate the auditory patterns generated by their peers. At the outset, the babble transpires capriciously; however, it is subsequently replicated on purpose (Wilson & Landa, 2019). Although young children acquire and select the phonemes of a language, they utilize those phonemes without comprehending their meaning. Waddington and Reed (2017) posit that a prominent indicator of ASD is a substantial setback in the acquisition of skills pertaining to phonetic expression, word formation, sentence construction, and the utilization of cognitive components in verbal communication.

According to the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition, the primary symptoms of ASD comprise deficient verbal and non-verbal communication abilities, as well as the manifestation of repetitive and stereotypical behaviors. According to a study by Brignell et al. (2018), the percentage of autistic individuals unable to develop or employ speech beyond a restricted scope range from 25% to 30%. Numerous studies indicate that a considerable percentage of children who have received an autism diagnosis possess proficient communication abilities, which may be limited or nonexistent, with estimates spanning from 25% to 61%. Children with autism who exhibit linguistic abilities are rendered incapable of communicating through language. Children possess the ability to understand the meaning and purpose of both verbal and nonverbal communication prior to acquiring language skills. This capability is associated with typical child development. In many cases of autism, however, language development occurs earlier and is distinct from communication. Furthermore, they utilize non-adaptive approaches to accomplish their communication goals rather than exploring alternative approaches to express their ideas and needs as a means of compensating for the lack of efficient communication (Radley et al., 2015). Children must be able to express their thoughts and emotions, feel a sense of security and protection, and receive the necessary assistance and support from adults and peers to function properly (Tran & Weiss, 2018). The correlation between early social competency and children's communication abilities, particularly language proficiency, is a widely acknowledged fact (Ruble et al., 2022). Three fundamental elements comprise the communication framework: form, content, and language. The practical language skills of children, denoting the way language is utilized to communicate meaning, are fundamental to their capacity for communication. Practical language comprises an extensive array of behaviors that involve the affective and social aspects of communication (Tran & Weiss, 2018).

The English language facilitates human interaction and communication on a global scale. Emphasis should be placed on enhancing the writing abilities of students with autism, in order to facilitate their successful progression through their academic endeavors and surmount obstacles (Almosa & Alzahrani, 2022). The significance of writing resides in its extensive application in both academic and professional spheres; therefore, students are ultimately equipped with the knowledge and abilities to effectively communicate, compose in English, and utilize such skills to navigate their daily lives and arrive at suitable judgments. The conventional method of instructing writing places more emphasis on the mechanics of the language than on its intended function (Al-Jboul & Al-Sharah, 2019). Writing was perceived as a mechanistic craft characterized by the mere replication of concepts and an emphasis on sentence construction, with little regard for the elements that contribute to the development of a meaningful text. Furthermore, there was an erroneous belief that instructing writing skills should solely concentrate on correct form, usage, and general structure. Most of the instructors' attention is directed towards grammatical and syntactical errors, which results in a disregard for students' proficiency in implementing the fundamental writing strategies (Alpat, 2019).

Consequently, writing proficiency has been overlooked in academic research and studies because of the challenges associated with teaching and learning these abilities. However, writing and skill development are widely regarded as among the most invaluable gifts bestowed upon humanity, given that they enable effective communication and facilitate the presentation of ideas, in addition to serving as a conduit for communication. Although developing the ability to generate ideas and articulate problems can be a time-consuming process for learners, it remains an essential element of acquiring a second language (Alqasham & Al-Ahdal, 2022).

Developing writing skills requires learners to not only acquire knowledge of specific language components, such as grammar and vocabulary, but also to comprehend the processes involved in language production, including the timing, rationale, and techniques. This activity takes place within a social-cognitive context and necessitates the ability to plan and draft effectively. Written communication is a crucial and intricate language skill that involves conveying thoughts and emotions to others through written form (Nasr, 2021). It requires careful consideration of content, style, and organization. Furthermore, there are differing perspectives about whether writing should be considered as a process or an outcome. It is seen as a method of information processing, namely, to broaden and enhance the writer's original thoughts. Alternatively, it is regarded as a sequence of procedures, involving both the practical engagement of pupils and the resulting textual outcome (Abdel Samad & Samah, 2020).

Written language abilities are considered a fundamental aspect of communication between two individuals, serving as a method of transmitting information. Language encompasses both oral and written forms of communication. Writing involves the use of symbols or letters to construct words that convey the intended meaning of the writer. According to Alqasham and Al-Ahdal (2020), the most effective approach to writing is to break it down into phases that are enough to master the abilities of each stage. This approach facilitates the improvement and advancement of these talents. The writing process consists of the following stages:

- The thinking stage that precedes writing: It is described as the longest stage of writing because it includes the process of choosing the writing topic and determining its purpose.
- The initial writing stage: It is characterized by randomness and improvisation, as the student develops the basic idea of the topic. A focus of discussion. The importance of thinking and writing appears in an unorganized manner at the beginning, and the student ends up creating what looks like disorganized diagrams, but they include all the elements of the topic.
- The initial text stage aims to acquire more skills, deepen their competencies, and develop the written text. From this stage, the text develops to resemble the completed topic.
- Review stage: In this stage, the student addresses the errors or defects mentioned in the initial text, organizes and arranges the paragraphs, and adds some details.
- The stage of revision and control: spelling errors are corrected, paragraphs are ensured and reviewed, margins are checked, the spelling is correct, and the font is clear and sound.
- Diffusion stage: In this stage, the written material is produced in its final form for several purposes, such as publishing it in the wall magazine inside the school or displaying it on the school radio.

Abdel Samad and Samah (2020) demonstrated that while assessing students' written work, it is essential to prioritize the internal coherence, interconnectedness, and cohesiveness of concepts, as well as their alignment with the presented information. The examination should encompass more than just grammatical, spelling, and punctuation mistakes. The written content may be evaluated based on several characteristics, including the accuracy, logical consistency, and structure of the concepts presented. Additionally, the right usage of language, appropriate terminology related to the topic, accurate spelling, legible handwriting, and overall organization are important factors to consider.

3. Previous studies

Al-Jboul and Al-Sharah (2019) explored the influence of a cloud computing-based educational software on the advancement of English writing abilities among tenth-grade students. The study included a total of 40 male and female students from The Jordan University School. The students were randomly assigned to two groups: an experimental group and a control group. The groups were formed from different sections of grade ten. To accomplish the objectives of the study, the researchers devised an educational curriculum and a writing proficiency assessment. The writing proficiency assessment was administered both before to and following the implementation of the instructional program. The experimental group received eight weeks of training with the newly created educational program, whereas the control group was exposed to the existing instructional program for the same duration. The results indicated significant differences between the two groups, which can be attributed to the impact of the instructional program on writing skills at all levels. The experimental group showed greater improvement compared to the control group. Additionally, there were significant differences in linguistic and discursive skills on the post-writing skills test, with females outperforming males.

Elhadi (2019) examined the influence of cloud computing apps on enhancing the critical reading abilities of secondary school pupils. The specific critical reading sub-skills that were focused on include: discerning cause-and-effect relationships, interpreting implicit ideas and information in the text, identifying main ideas, distinguishing between facts and opinions, recognizing the author's bias, differentiating relevant and irrelevant information, understanding the author's purpose, and inferring the antecedent of a sentence. The research included secondary students in their twenty-first year of education at Temai Al-amdid Secondary School, located in Dakahleia Governorate. The individuals were segregated into two distinct groups: The experimental group underwent training based on the prescribed training program using cloud computing technology. The control group had training using the conventional method of instructing critical reading abilities. The experimental intervention was administered in the second semester of the school year 2017–2018. The study employed a quasi-experimental methodology, namely a pre-post design with two groups: an experimental group and a control group. The purpose was to assess the efficacy of utilizing cloud computing in enhancing the critical reading abilities of first-year secondary-stage pupils. The

researcher devised and employed two instruments: a pre-post critical reading assessment and a questionnaire assessing critical reading skills. The findings demonstrated that the utilization of cloud computing tools resulted in a significant enhancement of participants' EFL critical reading abilities and a notable improvement in their attitude towards critical reading.

Nasr (2020) conducted an experiment to evaluate the efficacy of cloud computing in enhancing the writing abilities of university students in Saudi Arabia. The study included a total of 120 students who were randomly recruited from Al-Qassim University. These students were divided equally between the experimental and control groups. Both groups had a pretest. The students in the experimental group were instructed to use a proposed model that implemented a suggested cloud computing method. The pupils in the control group attended their usual writing lessons. Subsequently, the posttest was conducted. The results revealed statistically significant disparities between the average scores of the two groups on the post-test, with the experimental group demonstrating superior performance. Nevertheless, there were no substantial disparities in the average scores of males and girls in the experimental group following the test delivery.

Elseidy (2022) evaluated the feasibility of a suggested training program that utilizes cloud computing technologies in fostering reflective behaviors and self-efficacy among mathematics instructors. As an educator, they implemented an experimental program and utilized research instruments such as the cognitive achievement exam to assess reflective teaching abilities, the note card to evaluate performance elements of practicing reflective teaching skills, and the self-efficacy scale. The research findings demonstrated the program's efficacy in achieving its intended goals. A statistically significant difference was observed at a significance level ($\alpha \leq 0.01$) between the mean scores of the research sample who underwent the program in the pre and post-applications of the achievement test, observation card for reflective teaching skills, and the self-efficacy scale. The post-application showed higher scores in all three measures.

4. Method

The study utilized an experimental methodology to investigate the influence of an independent variable, especially a training program centered around cloud computing, on a dependent variable, namely the enhancement of writing skills in autistic pupils. The researcher chose a design from the experimental methodology that allowed for the creation of both a control group and an experimental group. This design entailed the arbitrary selection of a sample of children and the gathering of measures before and after the intervention. The chronological order of events unfolded as follows:

- There were 30 students in the sample, and they were randomly assigned to either the control or experimental group.
- Confirm that the students in both groups exhibit comparable degrees of competence in writing skills.
- The experimental group was exposed to the cloud computing-based educational program, while this was not the case for the control group.
- To evaluate the impact of the independent variable, post-test measurements were performed on both the experimental and control groups.
- A subsequent assessment was performed on the experimental group around one month later in order to determine whether the educational program based on cloud computing continued to have an impact and to validate that the improvement in the dependent variable (writing skills) was not merely temporary.

4.1 Population and sample

The study participants comprised pupils who had received an autism diagnosis from the Directorate of Education in Al-Mafraq City in Jordan during the period of January 15, 2024, to April 15, 2024. The participants comprising the research sample were chosen in accordance with the criteria delineated in the following manner:

- The optimal pupil age range is from eight to sixteen years old.
- According to the student's Ministry of Health-issued medical records, their capacity to respond and understand is unaffected by any limitations.
- According to the results of an IQ test administered in a Jordanian environment, the student's intellectual potential is estimated to be within the normal range. The student also shows signs of struggling with writing proficiency, according to the findings of the language assessment that was given to the students.

A sample size of 30 students, all of whom fulfilled the predetermined criteria, was allocated at random into two groups of 15 students each. The study employed a cloud computing-based instructional program in which participants were assigned at random to one of two groups; this group was designated as the experimental group. The control group comprised the remaining individuals who were not exposed to the cloud computing-based education program. The experimental sample participated in a cloud computing-based instructional program that was implemented for a duration of two months, encompassing ten sessions per month. This resulted in each student attending a total of twenty sessions.

4.2 Research Instrument

To achieve the research aims, two research instruments were utilized:

- 1- The researcher created an instrument for teaching writing skills to students with ASD using cloud computing technology. The scale has a total of 20 items, meticulously organized in a declining sequence based on their level of difficulty. The questions evaluate two distinct skills: linguistic skills, which are measured by 10 items, and content skills, which are measured by another 10 items. The scale was utilized as a quantitative instrument to measure the research sample in the pre-, post-, and follow-up stages.
- 2- The researcher developed a teaching program rooted in the principles of social constructivist theory. The program's implementation and evaluation aligned with the theory's recommended teaching strategies for educational outcomes. As part of this process, two study units (unit 2 and unit 6) were revamped using cloud computing technology, specifically the Google Drive application. The program aims to enhance the writing skills of autistic students by analyzing the components of two study units, including written topics, concepts, vocabulary, and activities. It focuses on helping students identify complementary or additional information and ideas in their writing, create distinct titles for their paragraphs, and express their feelings toward the texts they write.

4.3 Instrument Validity and Reliability

The validity of the measure was checked using two methods:

- 1- To assess the validity of the scale's content, it is presented to 10 arbitrators. The proportion of agreement and acceptance among the arbitrators, which is 80%, is used as the percentage.
- 2- The discriminant validity of the measure was assessed by presenting it to a sample of 12 experimental students with ASD. The F values produced statistically significant coefficients of discriminatory validity, namely 7.30 and 7.60, respectively.

The reliability of the scale was evaluated utilizing the internal consistency technique, in accordance with the parameters specified in Cronbach's alpha equation. The overall reliability coefficient was calculated to be 0.823, whereas the confidence intervals for the dimensions varied from 0.817 to 0.835.

4.4 Data Analysis

The data collection procedure was concluded, after which the average scores and dimensions of the pre-and post-tests were calculated. To assess the effectiveness of the program in enhancing the writing abilities of students with ASD, the researchers computed the effect size. The intended output was achieved by utilizing the Eta square. We employed the Z-value and the Wilcoxon test to quantify the level of dissimilarity between two samples with similar features.

5. Results and Discussion

The researchers ensured that the experimental and control groups had similar levels of writing abilities before introducing an educational program based on cloud computing, as seen in Table 1.

Table 1

Pre-test

Dimensions	Groups	N	M/R	S/R	U	Z	P
Linguistic skills	Experimental	15	8.70	130.50	28.00	1.450	0.250
	Control	15	8.40	126.00			
Content skills	Experimental	15	9.60	144.00	35.00	0.805	0.340
	Control	15	9.50	142.50			
Total	Experimental	15	9.15	137.25	31.00	1.100	0.300
	Control	15	8.95	134.25			

The data shown in Table 1 indicate that there was no significant difference between the experimental group and the control group in terms of their mean scores on the pre-test for the writing skills examination. To address the first question of whether there are any significant disparities in the efficacy of teaching programs utilizing cloud computing in enhancing writing skills among autistic students, we will compare the experimental and control groups. The subsequent table exhibits the outcomes.

Table 2

Post-test

Dimensions	Groups	N	M/R	S/R	U	Z	P
Linguistic skills	Experimental	15	13.80	207.00	6.00	2.800	0.000
	Control	15	9.10	136.50			
Content skills	Experimental	15	14.30	214.50	4.00	3.150	0.000
	Control	15	8.90	133.50			
Total	Experimental	15	14.05	210.75	5.00	3.000	0.000
	Control	15	9.00	135.00			

According to the data shown in Table 2, the experimental group exhibited significantly superior post-test scores in linguistic and content abilities, as well as the overall score, compared to the control group. This discovery implies that the students included in the study have a considerable degree of expertise in both linguistic and content-related abilities.

These results indicate that the study program had a beneficial impact on the group of children with ASD who were part of the trial, but the control group did not experience the same favorable effects. The researcher attributes the substantial improvement in the average scores on writing proficiency tests in the experimental group to the student's high level of technical proficiency, engagement, and enthusiasm in incorporating these platforms into their lessons following the completion of the training program. One plausible explanation for the observed effect is that these websites possess unique characteristics that differentiate them from other entities. The ability of this technique to promote the involvement of student cohorts in constructive activities both within and beyond the classroom is a notable benefit compared to conventional systems of education. In order to accomplish this objective, educational institutions must provide an environment that fosters the exchange and acquisition of information among students. The student now has access to direct proposal, transmission, receiving, tracking, interaction, querying, and commenting functionalities. Through self-study, he acquires new knowledge, improves his skills, and develops his own perspectives and understanding of the world. Consequently, he possesses the ability to engage in profound contemplation and evaluate several practical situations. The findings of this study align with the research conducted by Al-Jboul and Al-Sharah (2019), Nasr (2020), and Elseidy (2022). Regarding the second query, there are notable disparities in the efficiency of teaching programs that utilize cloud computing in enhancing writing skills for students with autism in the experimental group. The findings are displayed in the subsequent table.

Table 3

Pre/Post-test

Dimension	Pre/Po	N	M/R	S/R	Z	P
Linguistic skills	negative Rank	2	1.00	2	22.00	0.000
	positive Rank	13	7.00	91.00		
	ties	0				
	total	15				
Content skills	negative Rank	2	1.00	2	23.50	0.000
	positive Rank	13	7.00	91.00		
	ties	0				
	total	15				
Total	negative Rank	2	1.00	2	23.20	0.000
	positive Rank	13	7.00	91.00		
	ties	0				
	total	15				

The mean test scores in content and linguistic skills for the experimental groups exhibited substantial differences. The final evaluation findings exhibit significant diversity, as seen by the data presented in Table 3. The cohort of students in the experimental group demonstrated significant enhancement in their writing skills after the examination.

This might be attributed to the implementation of a cloud computing-based teaching program. Cloud computing technology, being a novel approach in education, has sparked students' enthusiasm to explore, engage with, and get hands-on experience in this field. Due to the students' interest, in addition to their regular teaching techniques, which were created as part of their routine, they want something innovative and in accordance with the current demands. The disparity in performance between the experimental group may be linked to the students' enthusiasm and lack of boredom when using the Google Drive program, as well as a sense of renewal and harmony in their work. This could also be attributed to the students instructing this program utilizing the social constructivist theory and the cooperative learning strategy. This approach necessitates students sharing their thoughts and ideas, presenting them through electronic files stored in the cloud, and collectively viewing them. Alternatively, students can individually download these files, ensuring privacy for both male and female students. You can consult it either in class or at home. The accurate implementation of the program can be attributed to several factors, including the clear and well-defined steps of the teaching program that students follow in each session, the clarity of the written topics, their alignment with students' interests, and their ability to stimulate critical thinking. Additionally, the provision of an active and meaningful learning environment has also played a role in ensuring the program's success. The findings of this study align with the research conducted by Al-Jboul (2019), Nasr (2020), and Elseidy (2022).

The last inquiry pertains to ascertaining the presence of a statistically significant disparity between the pre-and post-test scores of autistic students who received instruction in writing skills using a teaching program grounded on cloud computing. To provide an effective solution, it is crucial to promptly address the current issue. The findings are displayed in a tabular format. Table 4 shows that the average scores of the experimental group did not show any statistically significant differences based on the results of the post-test and subsequent evaluations. There were no differences after the program concluded, which supports the notion that the training was beneficial even beyond the follow-up period. The children's enhanced proficiency in writing abilities and their ongoing engagement in the program's activities adequately equipped them for the scenario, which might account for this outcome. The program's enduring influence persisted beyond the conclusion of the follow-up period, owing to the ongoing evaluation conducted throughout the session and the diligent completion of prescribed homework for each session. This clearly illustrates their high level of engagement and strong desire to acquire knowledge from this program. The students in the experimental group demonstrated more development due to the training program's deliberate design to limit distractions for youngsters. This entailed providing ergonomic chairs, sufficient illumination, and a lack of additional teaching materials like posters. The program's success may be ascribed to its utilization of a diverse range of teaching methodologies and advanced technologies. The instructional approaches and resources used audiovisual aids to facilitate students'

comprehension of the relationship between their actions and ideas, as well as provided real-life scenarios and chances for practicing and reproducing vocabulary in the target language.

Table 4

Post /Follow-up test

Dimension	Po/ Fol	N	M/R	S/R	Z	P
Listening skills	negative Rank	12	10.30	123.60	8.30	0.110
	positive Rank	0	0.00	0.00		
	ties	3				
	total	15				
Speaking skills	negative Rank	12	10.30	123.60	8.60	0.130
	positive Rank	0	0.00	0.00		
	ties	3				
	total	15				
Total	negative Rank	12	10.30	123.60	8.50	0.090
	positive Rank	0	0.00	0.00		
	ties	3				
	total	15				

6. Conclusion

The findings of this study provide support for the notion that individuals with ASD may get advantages from an instructional program centered around cloud computing. Furthermore, research indicates that cloud computing applications may be superior to traditional ones in enhancing the writing skills of these pupils. Hence, it is advantageous for educators to improve students' writing proficiency in the classroom to attain the program's goals. Cloud computing tools enhance the language and content abilities of youngsters with autism. The findings of this study indicate that the training program, which specifically targeted the enhancement of writing abilities, yielded greater effectiveness for the experimental group of children with ASD following their participation in the program. The higher mean scores on writing skills competency exams seen in the experimental group following the training program can be attributed to the students' technical ability, experience, and enthusiasm in integrating these platforms into their teaching.

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References

- Abdel Samad, S. M., & Samah, M. (2020). Developing EFL Reading and Writing Skills Through Using a Cloud-Based Collaborative Blended Learning Program a Research Paper. *Journal of the Faculty of Education in Mansoura*, 111(5), 175-195.
- Al-Adwan, T. (2023). Developing leadership skills for government school principals in light of digital transformation skills (field study in the University District Education Directorate). *Journal of the College of Education (Assiut)*, 39 (1), 206-228.
- Alashhab, Z. R., Anbar, M., Singh, M. M., Leau, Y. B., Al-Sai, Z. A., & Alhayja'a, S. A. (2020). Impact of coronavirus pandemic crisis on technologies and cloud computing applications. *Journal of Electronic Science and Technology*, 19, Article 100059.
- ALharahsheh, M., & Al-Dhiabat, A. (2019). The role of information technology in improving the administrative performance of the principals of Ramtha Education Directorate. *An-Najah University Journal for Research-B (Humanities)*, 35(4), 509-534.
- Ali, K. E., Mazen, S. A., & Hassanein, E. E. (2018). A proposed hybrid model for adopting cloud computing in e-government. *Future Computing and Informatics Journal*, 3(2), 286-295.
- Ali, M. B. (2019). Multiple perspective of cloud computing adoption determinants in higher education a systematic review. *International Journal of Cloud Applications and Computing*, 9(3), 89-109
- Al-Jboul, A. A., & Al-Sharah, N. D. (2019). The Effect of an Instructional Program Based on Cloud Computing on the Development of Writing skills in English Language among Tenth Grade Students. *Jordanian Educational Journal*, 4(4), 264-290.
- Almossa, S. Y., & Alzahrani, S. M. (2022). Assessment approaches of English language teachers in the Saudi higher education context. *Language Testing in Asia*, 12(1), 10.
- Al-Muraikhi, M. (2023). Improving the administrative performance of secondary school principals in Hafr Al-Batin Governorate in light of the requirements of artificial intelligence. *Journal of the Arabian Peninsula Center for Educational and Humanitarian Research*, 2(17), 1-21.
- AL-Omari, O. (2021). The Effect of Cloud Computing in Developing the Skills of Using Google's Educational Applications and Critical Thinking Amongst Mut'ah University Students. *Mut'ah Research and Studies, Humanities and Social Sciences Series*, 36 (5), 339-368.
- Alonso-Monsalve, S., García-Carballeira, F., & Calderón, A. (2018). A heterogeneous mobile cloud computing model for hybrid clouds. *Future Generation Computer Systems*, 87, 651-666.

- Alpat, M. F. (2019). *The effect of flipped learning-supported critical thinking instruction on the critical disposition and l2 writing skills* (Master's thesis, İstanbul Sabahattin Zaim Üniversitesi, Sosyal Bilimler Enstitüsü, Yabancı Diller Anabilim Dalı).
- Alqasham, F. H., & Al-Ahdal, A. A. M. H. (2022). Effectiveness of mind-mapping as a digital brainstorming technique in enhancing attitudes of Saudi EFL learners to writing skills. *Journal of Language and Linguistic Studies*, 17(2).
- AL-Safasfeh, J., & Al-Ajlouni, K. (2019). The effect of an educational program based on cloud computing on the acquisition of scientific concepts in science among eighth grade students in Jordan. *DIRASAT: EDUCATIONAL SCIENCES*, 46(1).
- Arpaci, I. (2019). A hybrid modeling approach for predicting the educational use of mobile cloud computing services in higher education. *Computers in Human Behavior*, 90, 181–187.
- Aydin, H. (2021). A study of cloud computing adoption in universities as a guideline to cloud migration. *Sage Open*, 11(3), 21582440211030280.
- Baldassarre, M. T., Caivano, D., Dimauro, G., Gentile, E., & Visaggio, G. (2018). Cloud computing for education: a systematic mapping study. *IEEE transactions on education*, 61(3), 234–244.
- Brignell, A., Morgan, A. T., Woolfenden, S., Klopper, F., May, T., Sarkozy, V., & Williams, K. (2018). A systematic review and meta-analysis of the prognosis of language outcomes for individuals with autism spectrum disorder. *Autism & Developmental Language Impairments*, 3, 2396941518767610.
- Elhadi, S. Y. M. (2019). The impact of cloud computing applications on improving EFL critical reading skills of secondary school students. *مجلة كلية التربية بالمنصورة*, 107(6), 19–35.
- Elhoseny, M., Abdelaziz, A., Salama, A. S., Riad, A. M., Muhammad, K., & Sangaiah, A. K. (2018). A hybrid model of internet of things and cloud computing to manage big data in health services applications. *Future Generation Computer Systems*, 86, 1383–1394.
- Elseidy, M. S. E. (2022). The Effectiveness of a Training Program Based on Cloud Computing in Developing Reflective Teaching Skills and Self-Efficacy Among Mathematics Teachers. *Education Journal*, 11(5), 214–230.
- Ismael, A., & Mubariz, A. (2020). The role of cloud computing technology in improving the quality of educational service (an applied study on higher education institutions). *Scientific Journal of Financial and Administrative Studies and Research*, 8(2), 305–356.
- Juma, M. K., & Tjahyanto, A. (2019). Challenges of cloud computing adoption model for higher education level in Zanzibar (the case study of SUZA and ZU). *Procedia Computer Science*, 161, 1046–1054.
- Komalasari, K., Arafat, Y., & Mulyadi, M. (2020). Principal's management competencies in improving the quality of education. *Journal of social work and Science Education*, 1(2), 181–193.
- Nasr, M. (2021). The Effectiveness of Cloud Computing in Developing Saudi-University Students' Writing Skill. *Jordan Journal of Educational Sciences*, 17(2), 313–324.
- Njenga, K., Garg, L., Bhardwaj, A. K., Prakash, V., & Bawa, S. (2019). The cloud computing adoption in higher learning institutions in Kenya: Hindering factors and recommendations for the way forward. *Telematics and Informatics*, 38, 225–246.
- Qasem, Y. A., Abdullah, R., Jusoh, Y. Y., Atan, R., & Asadi, S. (2019). Cloud computing adoption in higher education institutions: A systematic review. *IEEE Access*, 7, 63722–63744.
- Radley, J., Morilak, D., Viau, V., & Campeau, S. (2015). Chronic stress and brain plasticity: mechanisms underlying adaptive and maladaptive changes and implications for stress-related CNS disorders. *Neuroscience & Biobehavioral Reviews*, 58, 79–91.
- Ruble, L., McGrew, J., Dale, B., & Yee, M. (2022). Goal attainment scaling: An idiographic measure sensitive to parent and teacher report of IEP goal outcome assessment for students with ASD. *Journal of autism and developmental disorders*, 1–9.
- Samyan, N., & St Flour, P. O. (2021). The impact of cloud computing on e-Learning during COVID-19 pandemic. *International Journal of Studies in Education and Science (IJSES)*, 2(2), 146–172.
- Tajur, A. (2022). Cloud computing in the service of university education. *Ard Al-Sham Magazine*, 1(1), 1–16.
- Tran, C., & Weiss, B. (2018). Characteristics of agencies providing support services for children with autism spectrum disorders in Vietnam. *International journal of social science and humanity: IJSSH*, 8(4), 116.
- Vygotsky, L. S. (1978). *Mind in Society*. Cambridge: Harvard University Press.
- Waddington, E. M., & Reed, P. (2017). Comparison of the effects of mainstream and special school on National Curriculum outcomes in children with autism spectrum disorder: an archive-based analysis. *Journal of Research in Special Educational Needs*, 17(2), 132–142.
- Wilson, K. P., & Landa, R. J. (2019). Barriers to educator implementation of a classroom-based intervention for preschoolers with autism spectrum disorder. In *Frontiers in Education* (Vol. 4, p. 27). Frontiers Media SA.

