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Research Article

Shifting to D-learning during crises: Optimal experiences based on Saudi teachers of Deaf students' viewpoint

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ABSTRACT

Within weeks COVID-19 compromised months of planning and transformed in-class learning to a distance learning environment to which most students and teachers were not accustomed. This resulted in the circulation of an expectations-performance gap with regards to what could be realistically implemented to further support the learning of Deaf students. This qualitative study aims to determine the reality of using distance learning to teach Deaf students throughout the crises period in Saudi Arabia and attempts to examine the optimal distance learning practices for Deaf students. 30 hearing and Deaf teachers, chosen through a stratified random sample, participated. A developed semi-structured interview was used for data collection. The collected data was analyzed through the application of content analysis. The findings revealed that despite the benefits of distance learning in developing teachers' technology skills, they encountered numerous obstacles including administrative, technical, teaching, family and personal challenges. Several educational strategies and tools were suggested to help educators facilitate Deaf learning during the crises. The study reveals the required support from the Saudi Ministry of Education to make distance learning accessible for Deaf learners.

Keywords: teachers of Deaf students, distance learning, crises

INTRODUCTION

The COVID-19 pandemic led to the biggest impact on teaching styles across history; something which impacted 1.6 billion students around the globe (United Nations, 2020). This crisis limited the educational opportunities of many special needs students due to the lack of basic services provided to them.

The majority of governments across the globe, including that of Saudi Arabia, shutdown their educational institutes to limit the virus' spread and distance learning (D-learning) policies began being applied to teach the curricula. It is a type of learning that provides educational and training opportunities for learners whose circumstances do not allow their presence in a specific place and time, nor direct supervision by teachers (Aweidah, 2021). But it is not considered to be effective if the learner's technical-skills are not developed (Mahmood, 2020).

D-learning was not actively used, prior to the pandemic, in most Saudi schools including disabled schools in addition to their staff who do not know what D-learning involves. Therefore, if D-learning was not suitable for students with disabilities and for the use of communication strategies and facilitating educational materials then they may simply be excluded (Human Rights Watch, 2020).

The rapid and unplanned transition to D-learning presents challenges for teachers of Deaf[1] learners in all educational levels (Al-Subaie & Alasfor, 2021) this could be because of Deaf learners' distinct linguistic and communicatory requirements. Teachers of Deaf students did not devise plans for a different educational

[1]Deaf with 'uppercase D' describes individuals who identify themselves as culturally Deaf and they always use sign language.

strategy during the pandemic, because their preparation programs in Saudi universities did not pay attention to using D-learning technologies before the pandemic.

It is expected therefore that teachers used various strategies and tools most of which have probably been used for the first time in an attempt to meet the educational requirements of impacted students. Indeed, Alsadoon's and Turkestani's (2020) study revealed that 11 female lecturers, who used D-learning with Deaf students, faced difficulties with time-consumption, students' poor writing skills and technical issues.

Deaf students in all educational levels were fully excluded during the pandemic; they faced more challenges than hearing students using D-learning because no alternative educational strategies were devoted to them. 65 Saudi male Deaf university students in Aljedaani et al. (2021) reported that the electronic-learning tools were not as accessible to them leading to increased stress and ineffective teacher-student communication.

The majority of Saudi scholarly articles' focus is limited on the perspective of hearing professors and their Deaf students regarding the effect of D-learning during COVID-19 (Aljedaani et al., 2021; Alsadoon & Turkestani, 2020). There is a lack of published studies that explicitly showcase the challenges encountering Deaf and hearing school teachers during D-learning sessions. Moreover, there is a lack of available studies that precisely outline the appropriate strategies and tools to facilitate such sudden transitions for Deaf students.

This is the first study to concentrate on gathering data regarding the unexpected gains of D-learning and the challenges confronted by Deaf students' Deaf and hearing teachers from five Saudi regions throughout the transfer to D-learning; in addition to discuss strategies and tools that could potentially enable teachers to avoid such challenges. The implications of this study will advise policy and practice and enhance the D-learning methods during the global crisis.

LITERATURE REVIEW

Deaf Education Prior to the Crisis

Since opening the first Saudi Deaf school in 1964, traditional learning, which involves face-to-face interaction between teachers and Deaf students and using whiteboards, hand-written assignments, is applied in Deaf schools. The curricula follow a standard format utilizing government textbooks. Deaf students depend entirely on hearing teachers for learning the subject.

Teacher-preparation programs for Deaf students in Saudi universities, that prepare hearing teachers only, offer theoretical, cultural, and scientific courses, one sign language course, and field training for Deaf education prior to joining service. There is a gap between what the student-teachers receive in universities and teaching skills that they require to teach the Deaf; including insufficient training in effective usage of technology tools to enhance teaching leading to an absence of technology-based teaching methods (Alzahrani, 2018). There is a lack of evaluation of sign language teacher's skills before joining service. 34 teachers of Deaf students in Eisaa's (2019) study focused on using course's signs instead of translation signs, did not pay attention to sign language performance and hand-movement direction, and they do not employ facial expressions in communicating the message.

Deaf teachers displayed a lack of presence within Saudi Deaf schools because Deaf graduates were not employed in the educational sector. The available Deaf teachers in Saudi's schools, who can be counted on the fingers of one hand, were appointed 25 years ago with a secondary certificate. The number of Saudi qualified sign language interpreters reached 103 in the last seven years (Saudi Association of Sign Language Interpreters, 2022); however, the chances of receiving a job in Deaf schools are almost non-existent.

Blended-learning system (i.e., electronic and traditional) are used in Saudi schools for the Deaf with developed technology being used to a limited extent. Using modern technology such as sign language videos and online learning in teaching English to Saudi Deaf learners motivates them to participate in learning English, but technology utilization is still limited (Al-Zaylai, 2019).

D-learning; however, did not exist as far as we know due to the lack of specialized D-learning platforms, in addition to technical, financial and administrative factors that were reported by 92 Saudi teachers of Deaf

students while employing educational technologies (Al-Tuejeri, 2014). These challenges include teachers' lack of technology usage abilities; the scarcity of beneficial programs the lack of plans to integrate technology into Deaf teaching and the shortage of electronic-based sessions for Deaf learners.

Moving to D-Learning During Crises

D-learning in Saudi Arabia began as a future plan, then in March 2020 turned into an urgent need due to the pandemic, and today it is going through the maturity stage of the experience. All educational organizations moved to a completely D-learning platform provided by the Ministry of Education including Vschool (Madrasati) (Saudi Press Agency, 2020). Madrasati is considered as one of the top-seven worldwide virtual school platforms between 174 countries in meeting the epidemic challenges (Unified National Platform, 2012). It contains

(a) IEN TV channels for course delivery,

(b) IEN national e-portal for educational materials (Saudi Press Agency, 2020), and

(c) Future Gate platform for interactive learning (Saudi Ministry of Education, 2021).

Among several countries, Saudi teachers and learners struggled due to the sudden adoption of D-learning. In a study by Al-Eid and Bedouin (2020) to explore the viewpoint of 97 Palestinian instructors during the pandemic, they stated that the negatives of D-learning far outweigh its positives, likely due to poor infrastructure and the siege of Gaza. In a Jordanian study that included 746 students, Al-Salman and Boanah (2021) found that 36% of the sample faced challenges during D-learning, including lack of internet services and students' skills using platforms. Al-Otaibi (2020) attempted to identify the impediments that faced 412 Saudi parents during the pandemic and found that learners did not achieve the maximum possible benefit, as not all possible means of education were optimally employed.

D-Learning for Deaf Learners During the Crisis

The recent emerging transition to D-learning in all school levels in many countries including Saudi Arabia led to many challenges with Deaf students. Teachers were pressured into creating activities and materials within a week, and adjustments for Deaf learners required a greater time period. D-learning; therefore, should enable students to view captioned videos and search for critical words thereby assisting students with a different primary language to the instructor and those with unclear speech (Edmonds, 2004).

The characteristics of Deaf students (such as their dependence on visual communication, having qualified sign language teachers, using note takers and using Saudi sign interpreters) need to be considered by their teachers during the educational process. This could be possible during face-to-face education; however, this could be challenging while using D-learning. Indeed, during the pandemic, D-learning challenged Deaf learners due to their literacy difficulties and reading comprehension challenges imply that text should be minimized when developing D-learning courses (Lynch et al., 2020).

Saudi Deaf students were also in full exclusion because the Future Gate, which is providing e-educational services to develop students' and teachers' skills, does not mention Deaf students or any other learners with disabilities; no educational channel provides a sign language translation se service. In a quantitative study, Al-Kulaib (2022) investigated the impediments of D-learning from the views of 105 Saudi female hearing teachers of Deaf and hard-of hearing students in Dammam City and found that the teachers met obstacles related to the nature of the Deaf curriculum, families' poor communication as well as the students' characteristics.

Deaf students have also faced many social and educational challenges in D-learning. The Emirati study by Alshawabkeh et al. (2021), which included three instructors and 11 university Deaf students, showed that D-learning helps develop instructors' skills in acclimating to a changing environment and enhancing their technological capabilities; however, there was an absence of social interaction between the instructors and the Deaf students, an apparent failure to communicate with the Deaf and difficulties in using new technologies. In a Saudi quantitative study, however, Bashatwa (2021) sought 35 teachers' perspectives on blended education (traditional and online-learning) in Taif City, they found that blended learning contributed to developing Deaf and hard-of-hearing students' social skills at a higher level compared to academic skills, which recorded an average improvement.

Preparing certified teachers for Deaf students requires professional commitment and proficient impact on learning. This process in D-learning; however, subjected several challenges. Only Alawajee's (2021) study investigated 24 Saudi female students whose education was through an online platform in one of the teacher preparation programs to comprehend students' experiences regarding the corona pandemic's impact on their preparation. D-learning restricted most students' sign language due to limited engagement with the faculty and each other. This led to disinterest which diminished students' confidence in their sign language abilities and limited their observation of hand-movement and facial expressions. Conversely, other participants' technical skills improved, and their self-learning abilities enabled them to learn in an accessible environment without fear of mistakes or judgement.

Alternative Teaching Strategies for Deaf Learners Throughout Crises

Teachers of Deaf students used different strategies and tools during the crises. They used technology based online-learning, virtual technologies (Webex Meet), Telegram and TV (Nisa et al., 2020). Deaf students used remote-microphone technology, tablets and splitters to allow for multiple audio outputs or inputs at home; a significant majority of caregivers and students, however, reported technological issues (Schafer et al., 2021). Recorded lessons were also accessible to interpreters as applicable to the student (Alshawabkeh, et al., 2021).

Deaf students encountered difficulties in using Canvas System as D-learning is new to them (Caupayan & Pogoy, 2021) and lost auditory-signal attenuation and visual cues arise due to face masks (Goldin et al., 2020). Using sign language had a significant impact on effective workload of Deaf students (Richardson & Woodley, 2001); however, during D-learning new work formats for sign language interpreters and more efficient educational technologies were required, as suggested by Kokhan et al. (2021). 11 Saudi female lecturers of Deaf students used the Blackboard and Zoom Systems during D-learning, and they encountered challenges related to lack of experience with these systems which prevented them from communicating with their students (Alsadoon & Turkestani, 2020).

The conclusion is that no one can deny the contribution of D-learning to the continuation of the educational process for Deaf students in a physically constrained environment. However, strategies and tools used in D-learning are not fully inclusive. Indeed, a number of studies confirmed that many Deaf students throughout Saudi and around the globe were likely lost during the transition from traditional learning to D-learning. This is because they are part of a heterogeneous group, and their hearing-impairment clashes with an assumption of the D-learning models. Deaf students' visual organ can be overwhelmed as they can only utilize their eyes to comprehend the teachers' message which is not the case with hearing students.

Interestingly, there has been several quantitative studies that explored the impact of D-learning during the crises on Deaf students from hearing teachers' perspectives in a single Saudi city, on a specific gender (e.g., Al-Kulaib, 2022), while other studies have investigated the families of Deaf students' perspective on D-learning (e.g., Alshdalfat, 2021), whereas further research explored the impact of D-learning on Deaf students (e.g., Aljedaani et al., 2021). However, it is evident, since the start of the crisis, that there are still shortcomings in research related to the use of D-learning for the Deaf category in an effective way especially with regard to appropriate teaching strategies for Deaf students, the obstacles that Deaf and hearing teachers face while teaching Deaf students from a distance and suggestions for dealing with them. Through a qualitative study, therefore, this research attempts to examine the actual use of D-learning in educating Deaf students from male and female Deaf and hearing teachers' viewpoints within several regions of Saudi Arabia throughout the COVID-19 epidemic. More importantly, new thoughts of the most appropriate tools and strategies to facilitate D-learning for Deaf students particularly during the crises, are shared in this study.

To achieve the study's aim, the following questions were explored:

1. What is the reality of D-learning in teaching Deaf students from the teachers' viewpoint in Saudi Arabia during the COVID-19 epidemic?
2. What challenges are encountered by teachers during D-learning sessions?
3. What strategies and tools did the teachers use to handle the encountered challenges in D-learning sessions?
4. What are the suggestions for improving the D-learning experience for Deaf students?

Table 1. Teachers' demographic characteristics

Characteristics	n	Percentage (%)
Teachers	30	100.00
Gender		
Male	15	50.00
Female	15	50.00
Teachers distribution by school level		
Primary	6	30.00
Secondary	7	35.00
High	7	35.00
Teachers by hearing status		
Deaf female	1	3.33
Hearing male	15	50.00
Hearing female	14	46.67
Teachers by region		
Southwest	8	26.67
Central	6	20.00
Western	6	20.00
Eastern	4	13.33
Northern	5	16.67
Southern	1	3.33

METHODS

Participants

29 hearing teachers (15 male and 14 female) and one Deaf female teacher agreed to participate in the study. They were purposefully selected form 20 public schools (six primary, seven secondary, and seven high) within six Saudi regions to ensure the presence of an equal number from both genders and each stage of mandatory education (Palinkas et al., 2015). **Table 1** shows the demographic data of the participating teachers. Due to precautionary measures, the researcher conducted all the interviews with hearing teachers throw a phone call; each took half-an-hour; whereas a video interview through Zoom was conducted with the Deaf teacher and took one hour. Only three interviews were recorded based on the desire of teachers; therefore, extensive written notes were taken throughout. A qualified interpreter was involved in the interview with the Deaf teacher to increase the accuracy of the collected information, because the sign language skills of the interpreter in addition to her experience and knowledge of interacting with Deaf people can vary (The Centre for Deaf Studies, 2005).

Data Collection

The researcher set up a semi-structured interview format to gather the required data. It considered the literature review and the purpose of the study as well as being in line with the views of five field experts.

The semi-structured interview method minimizes potential bias (Adams & Lawrence, 2008), while gathering most of the relevant information related to the topic in question. The reliability and validity of the interview questions were checked through a pilot study with four (two male and two female) teachers of Deaf students from different Deaf schools. The interview form is comprised from two sections: firstly, demographic related questions; secondly, open-ended questions regarding the teachers' views about the reality of D-learning in teaching Deaf students. A message to "What's App" groups was sent to invite the teachers for participation in the interview. The nature of participation and the aim of the study were described in the message. After the teachers' permission to be involved in the interview was gained, they signed the informed consent form, which consisted of the study's description, and indicated that the participating teachers could, at any time, leave the study without any consequence. Using pseudonyms and confidentiality were guaranteed for the participants.

Data Analysis

The reality of D-learning in teaching Deaf students in Saudi Arabia was discussed. Thematic analysis combined with content analysis was used to analyze the gathered data from the semi-structured interview

(Billups, 2021). The analysis began through organizing the teachers' answers into themes applying the Arabic language to ensure none of the Saudi culture related nuances are lost. The main points, gathered from the interview data, were therefore translated. Teachers' answers were coded and classified as such. Finally, the study's themes identified in light of the collected data which would provide substantial meaning with regards to the research questions. Respondent validation was then used to ensure the validity of the concepts and themes which emerged from the interviews (Harper & Cole, 2012). Each teacher was provided with a pseudonym to increase anonymity.

FINDINGS AND DISCUSSION

The findings of this study are categorized into four sections.

The Reality of D-Learning in Teaching Deaf Students

Regarding the first research question 'what is the reality of D-learning in teaching Deaf students from the teachers' viewpoint in Saudi Arabia during the COVID-19 pandemic?', the findings displayed some interesting trends in teachers' reactions from both genders regarding D-learning. Seven teachers reported that D-learning is a qualitative leap in Deaf education. Mr. Abdullah responded that "I see that D-learning has improved teacher's and student's performance, enhanced our use of technology, and developed our ability of providing learning in an easier and faster method".

23 teachers, however, are dissatisfied with continuing to use D-learning, as their Deaf students were incapable of fulfilling the predicted progress in language learning performance. Mrs. Hala said: "D-learning is important, but it's considered very difficult with Deaf students, we therefore took permission from the Minister to bring Deaf students to school and have a hybrid education".

The Challenges Encountered by Teachers

In respect of the second research question, 'what challenges are encountered by teachers during D-learning sessions?', the findings revealed many challenges which are grouped into five main categories.

Administrative challenges

It was found that 21 teachers emphasized that the school administration had a role in finding solutions and presenting various proposals to facilitate the educational process. Mrs. Dina pointed out:

> The educational supervisors gave teachers the freedom to manage the educational process as they saw fit based on the students' conditions, i.e., class time and assessment methods. The school also provided laptops and iPads for needy families, internet in the schools, and trained the students who had difficulty accessing the platform.

Nine of the teachers; however, faced challenges with the administrations and the poor training provided regarding D-leaning methods for Deaf students. Mr. Salim indicated: "there was no preparation for us nor for Deaf students to face the crisis before beginning the school year". Whereas, Mr. Sultan said: "we obtained general courses for teaching hearing students using technology … such us the *Teams* program, without consideration for Deaf students' needs." Furthermore, Mrs. Enas expressed that "although the courses were good, some of them were not scheduled appropriately". These findings could be due to the school administration's interest in the procedural work related to their field of work as administrators rather than giving more importance to the training aspect.

Another challenge that emerged was meeting the unprecedented requirements. The teachers revealed that they worked tirelessly to do their jobs effectively in order to overcome the confinements of a D-learning environment. Mrs. Fuoz said that

> There're lots of requirements from the teachers such as writing experiences and solving the problems of educational loss, which caused us physical and psychological exhaustion, and such requirements do not serve the educational process, especially in that critical time.

This result confirms Al-Shiha's (2005) findings. This could be due to the modernity of the D-learning system, the teachers need to develop their skills in D-learning, and the lack of a clear mechanism for the burdens assigned to the teachers, which leads to the accumulation of tasks on them.

The lack of specialization of school leaders in Deaf schools was one of the challenges faced by teachers. Mrs. Sarah revealed:

> The educational supervisor has no experience in Deaf education … I asked her to modify the skill "audio comprehension" to "signal comprehension", but she did not agree, and considers that this's an important skill that develops students' memory, although I explained that Deaf people have short-term memory, and lack the ability to store information for a long time.

Based on the Saudi Deaf education regulations, the administration of Deaf schools must be qualified in hearing-impairment; however, many schools for the Deaf in some smaller Saudi villages are still run by unspecialized administrative staff, which explains the difficulties experienced by teachers in not understanding their and the students' needs.

Technical challenges

17 of the participating teachers indicated that many of the technical programs facilitate the educational process. Mrs. Safia reported "using technical programs during D-learning allows teachers to teach at any time in accordance with their students' needs".

Mr. Omar added:

> Using the smart board to present the textbook and video talk with students in sign language is one of the best programs that my students have benefited from because it's as if I was in front of them in class.

13 teachers; however, revealed different technical challenges they encountered. One of the main problems is that lack of availability of electronic devices (computer, and so on) used by Deaf students or poor quality which hinder the clear access to information. Mr. Saeed reported that "three of my students could not provide a computer at the beginning of the crisis". Mr. Akram also stated that

> Using some e-books (pdfs) and YouTube clips related to the Arabic lessons was not to the desired level because the quality of the students' camera did not help them view the presentations and convey facial expressions, lip reading and sign language clearly, and it's a time gap for the students.

Mrs. Dina also expressed that

> There was difficulty communicating with the students due to the low economic situation of the family who was unable to provide devices and internet for their children or the presence of one device at home, while there was more than one child.

A further challenge that emerged was that the 'IEN' channel's [the national e-portal] services are still limited for some educational lessons and do not meet Deaf students' educational needs. Mrs. Lama said that

> The virtual laboratories in chemistry in the 'IEN' channel were very useful in communicating information to the students, but there were no clips for all physics subjects, therefore there was great difficulty in communicating the information of this material.

Generally, most of the Arabic educational programs are designed specifically for hearing students; after that, educators begin to apply them to Deaf students, but they face challenges and the benefit from them may be limited. In this context, Mrs. Fuoz revealed that "many of the used educational applications lack the feature of showing translation in sign language".

As a previous teacher for Deaf students, this could be explained by the fact that the educational technology library suffers from a lack of Saudi sign language materials, which establishes barriers regarding the quality of education and limits Deaf students from benefiting from the available programs.

The students' transition between looking at the text content and at the teacher's explanation at the same time caused further technical problems. The interview with Mrs. Sarah also explained:

> During D-learning, it was difficult for me to provide an indicative translation of the test instructions, because when students exited the test to see the teacher's sign language through another link, this would cause the test to stop, and the score would be lost.

The weakness of Deaf students' skills in using technological programs was a further challenge faced by teachers. Mrs. Manal found that "some technological programs are somewhat difficult for Deaf students, such as 'Wordwall', because of their poor technical skills; students therefore need a training course before starting to use such programs". This finding could be due to the reliance of many Deaf students' teachers on the traditional teaching method and the scarcity of using technological programs as a result of schools not providing Internet service in the classroom specifically. Moreover, Deaf students study computer skills only twice a week and without home training for digital skills; from our work with the Deaf, we noticed the economic inability of the Deaf students' families to provide computers for their children.

Teaching challenges

Six teachers expressed their positive experience of teaching Deaf students during D-learning, which improved their digital performance in handling change. Mrs. Mariam reported

> D-learning has greatly contributed to developing my teaching skills in dealing with electronic measurements, classroom management and teaching methods to achieve the desired goals through my attendance at the professional development project courses.

Mr. Fahad added

> My experience with D-learning is good, because the educational process was done professionally and its development is based on Aramco … the teaching process was enjoyable for me and my students … smart screens, projector with touch, synchronized programs, phones, and smart boards were available to them.

D-learning removed the challenges of travelling to school for Deaf students. Mrs. Khulood said:

> It's been known that the lack of transportation is one of the challenges that Deaf girls face to reach school, D-learning, however, has contributed to the elimination of this issue, so the absence of female students has become very limited.

This is a big problem in some Saudi schools for the Deaf. In most cases, transport companies contracted with the Ministry are late in operation. Therefore, students who live in the far south of the city need to travel an hour a day to get to school in the far north.

24 teachers, however, faced different teaching challenges. They indicated that the teaching load for them requires more effort than traditional education. Indeed, Mrs. Majedah noted that

> Educating Deaf students at a distance requires more work than traditional education, preparing lessons and responding to inquiries of students and their families requires more time along with preparing home assessment activities and test questions as well as special responsibilities with our family, all of these are at the expense of our psychological and physical health.

In this context, Mr. Bakor stated that

> Although D-learning was the perfect solution during the COVID-19 pandemic crisis, it caused us lots of stress, as we need lots of time to experiment with many educational applications and then evaluate them to choose the once suitable for Deaf students, and we need additional time to teach our students and their families how to use such programs.

The teachers' stress is related to the unexpected change in the pattern of education and the teachers' work, especially that D-learning was not used before in Saudi schools for the Deaf.

The lack of direct interaction among the student and the teacher or among the students themselves was one of the challenges that most teachers faced. Mr. Bader expressed that

> We cannot say that D-learning with Deaf students is highly successful because feedback and communication with them are much less than in face-to-face education … the lack of simultaneous indicative translation service for text or use of audio content without transcripts or captions might impede understanding of the information and thus cause poor class interaction.

Mrs. Sarah reported similar concerns stating that "one of the most negative aspects of D-learning is the poor interaction with Deaf students, especially that most female students refused to open the camera, which leads to them losing lots of information". Mrs. Dina expressed "my problem was with Deaf students experiencing profound loss of hearing and non-Arab Deaf students; I cannot communicate with them; thus, the mother is contacted to follow up on the students' progress".

The above quotations show how teachers used different technological programs during D-learning; however, they still suffered from poor student interaction. This could be due to the unavailability of sign language interpreters in schools of the Deaf and the poor quality of the internet. The weak sign language skills of teachers could be another reason; alongside their use of conventionalized manual gestures in teaching, consequently, Deaf students lose good communication. A sign language interpreter should be involved in D-learning to remove the communication barriers.

Family challenges

21 teachers emphasized the important role that families played in the educational process during COVID-19, for instance, Mr. Fahd expressed:

> The family's role in the educational process is completely different from their role during traditional education; families have become more interested due to their presence beside their children while using the educational platform and solving the technical problems faced by their children.

Nine teachers; however, stated that some families had a little to no role in this process. Some challenges related to the absence of the family's role in supporting students' education during the D-learning period. Mrs. Sarah pointed out that:

> Some families are not interested in their daughters' attendance in the online sessions, as many students' name are in the list but without participation, and when asked, the mother says that her daughter is busy with online games!

This finding could be explained by the difficulty of balancing students' needs and parent employment demands, lack of personal time for parent or parents' negative attitudes towards educating a Deaf child especially towards Deaf girls.

Another challenge is the families' baseline knowledge of D-learning, technological competence and the potentially limited ability to handle technological issues. Mrs. Lama said:

> At first, families were non-serious about D-learning, students were late in entering the virtual class, and the family was unable to access the educational platform and the existence of a technical problem and their ignorance of addressing it caused delays.

This result is in line with Schafer et al.'s (2021) study, which attributed this result to the family's lack of awareness of D-learning methods, and to the lack of technology-based training.

Some families misunderstand their role in supporting their Deaf children during D-learning which could lead to the student's lack of self-reliance. Mr. Fahad pointed out that "some families did the homework for their children, and this was noticed because of the difference in handwriting". This could be due to technical

reasons that impede the students' access to information, or the weakness of the teacher's sign language skills, which hinders the students' self-reliance in performing school tasks.

The hearing status of the parents and the Deaf students within the family was a further challenge for teachers. Mr. Samer noted that

> The families' role and interaction decreased in two cases: if they'd hearing children at the same stage as the Deaf child, thus they paid attention to the hearing child; and the other case is when the whole family is Deaf.

This could be explained by the lack of family's belief in the importance of educating their Deaf children, just like their hearing siblings. Again, teacher's poor sign language skills potentially hindering them from communicating effectively with Deaf students and their Deaf parents was a contributing factor.

Analyses based on Organization for Economic Co-operation and Development (OECD) during the COVID-19 epidemic found that there was a strong positive correlation between parental emotional support and students' positive approach towards learning and students' self-efficacy (OECD, 2020). Educational systems, therefore, should attempt to enhance the engagement level among schools and families to enhance available information and assistance to parents on efficient methods of support for students' learning not only in normal times but also during exceptional conditions associated to COVID-19. Establishing a national web platform as a resource for families and teachers of Deaf students; therefore, has become essential. It aims to support teachers and families, develop their social, emotional and technical skills, stimulate critical and creative thinking, provide financial support to families with limited income, and provide guidance to achieve a well-balanced level of activities.

Personal challenges

Sex female teachers stressed the importance of opening the camera with Deaf students, Mrs. Fuoz stated

> I was keen to teach my students through a camera as I was writing on the board and using sign language during the explanation … therefore, I preferred them opening their cameras to ensure that they understood the content, as they could not speak, and I could not tell if they understood the lesson or not.

Mrs. Hala reported: "I had no problem opening the camera during the lessons, but many of my students' families reject this idea because they consider it a violation of their community privacy".

Conversely, two female teachers supported opening the camera to some extent. Mrs. Manal said: "I used to open the camera when necessary, especially while assessing the students".

Seven female teachers; however, completely refused to open cameras while teaching Deaf students remotely due to their fear of being photographed by students. Mrs. Khulood said

> I relied on the PowerPoint and the Whiteboard to teach Arabic, monotheism and jurisprudence, but their effectiveness was acceptable due to the lack of communication and lip-reading between me and them as I'm veiled, and I cannot open the camera because it's possible for the students to photograph me by mistake.

All the male teachers; however, opened the camera during the lesson due to the lack of religious and cultural constraints as opposed to females who must cover their face.

The conservative nature of the Saudi society, which is characterized by its diverse cultural backgrounds, has made the issue of opening the camera during D-learning a subject of contention between female teachers and families. Opening the camera while teaching Deaf students remotely is not an option but rather a necessity due to a significant proportion of Deaf students' educational attainment depends on visual communication through the students' seeing the teacher's sign language. Therefore, the student should sit uninterrupted in and use a movement and sound monitoring program (responds lock down browser) to ensure the student is alone and without access to a phone.

Table 2. D-learning strategies

Strategies	Male teacher		Female teacher		Total (n=30)	%
	Frequency (n=15)	%	Frequency (n=15)	%		
Sign language	15	100.0	9	60.0	24	80.0
Writing	1	6.7	6	40.0	7	23.3
Speech reading	0	0.0	2	13.3	*2*	6.7

Teachers' family engagement decreased in D-learning as stated by 24 teachers (9 male and 15 female). Mrs. Khulood stated

> I used to spend more than ten hours a day on the computer and phone in order to prepare lessons, assess and communicate with the students' families; but more than that … the school administration holds meetings and training sessions in the evening … all this was at the expense of our health, psyche, and family members whom we did not have enough time to spend with.

Creating a national platform, as recommended above, can help teachers exchange experiences and resources among themselves and reduce the time teachers spend preparing for lessons … the platform can also provide the service of psychological and social counselling for the teachers and training courses that help them in establishing a work-life balance.

D-Learning Strategies and Tools

Regarding the third research question, "what strategies and tools did the teachers use to handle the encountered challenges in D-learning sessions?", the findings of the teachers' opinions about the strategies used to meet the challenges faced during teaching Deaf students in D-learning are presented in **Table 2**.

As can be seen from **Table 2**, different strategies were used by the teachers in dealing with the challenges faced during teaching Deaf students through D-learning. Sign language is the most significant strategy used by both male and female teachers (80%). All male respondents used sign language (n=15) compared to only 9 female teachers, compromising 60% of the female sample. Mr. Abdullah responded that "the education of Deaf students relies on visual communication; therefore, sign language was a very effective strategy with my students". Speech reading was stated by only two female teachers, who used it with sign language. A significant point was made by Mrs. Amal (a Deaf teacher), who stated:

> I used to explain lessons in Saudi-Sign-Language, and speech reading to consider the students' individual differences … because the level of information comprehension or language understanding of some students is weak due to the lack of continuous communication with the family in sign language; therefore, they do not understand the spoken language or sign language; thus, I reveal my face and explain to them in the appropriate sign language.

This finding could be explained by the fact that there are no cultural or religious constraints for male teachers to open the camera which is why they use sign language in D-learning as opposed to females who have to cover their face in public. From the quotes above, it also seems that there was a sign environment during D-learning. However, it is difficult to ensure whether it was a sign language or sign-supported-Arabic environment especially with hearing teachers because our previous ethnographic evaluation (Basonbul, 2018) of Deaf students' teaching methods found that sign-supported-Arabic was used by the participating teachers and none of them had taken any sign language courses.

Using the writing strategy was also reported by 8 teachers. Four female teachers used writing in addition to sign language, while only two of them used writing only. Two female teachers used speech reading with sign language; but no male teacher used speech reading. Mr. Faisal stated: "the communication between me and my students was done through sign language and writing on the Whiteboard to teach religious subjects and Arabic"; Mrs. Jana said: "because I did not open the camera; I used the written chat in the *Teams* program to teach the Qur'an, Arabic and social studies".

The main point is that sign language strategy differs from the writing strategy and speech reading; and most Deaf monolingual and bilingual learners are likely less capable in writing than speaking and are also less

Table 3. D-learning tools used by the teachers

Tools (programs & applications)	Male teacher		Female teacher		Total (n=30)	%
	Frequency (n=15)	%	Frequency (n=15)	%		
IEN [e-portal]	11	73.3	14	93.3	25	83.3
Camera	15	100.0	8	53.3	23	76.7
YouTube Clips	15	100.0	8	53.3	23	76.7
Microsoft Teams	4	26.7	9	60.0	13	43.3
WhatsApp	0	0.0	10	66.7	10	33.3
Microsoft PowerPoint	0	0.0	8	53.3	8	26.7
Liveworksheets	1	6.7	4	26.7	5	16.7
Wordwall	0	0.0	3	20.0	3	10.0
Microsoft Forms	0	0.0	3	20.0	3	10.0
Microsoft Whiteboard	0	0.0	2	13.3	2	6.7
Tarjuman	0	0.0	2	13.3	2	6.7
ActivInspire	0	0.0	2	13.3	2	6.7
Zoom	0	0.0	2	13.3	2	6.7
Signed Quran	1	6.7	1	6.7	2	6.7
Telegram	2	13.3	0	0.0	2	6.7
Teaching Aids (images, ...)	0	0.0	2	13.3	2	6.7
Padlet	0	0.0	1	6.7	1	3.3
Whiteboard.fi	0	0.0	1	6.7	1	3.3
Interactive Whiteboard	0	0.0	1	6.7	1	3.3
Google Duo	1	6.7	0	0.0	1	3.3

capable in speaking than reading. Relying on one strategy over the other; therefore, highlights an issue in deaf education.

The teachers also used different educational tools during D-learning; they are presented in **Table 3**.

It can be seen from **Table 3**, that twenty tools were used by teachers to overcome challenges during D-learning; and there are programs that seemed to be preferred by male teachers and others by female teachers. The 'IEN' educational channels are more frequently used as indicated by 83.3%of the research sample perhaps as it is the official program approved by the Ministry; female teachers constituted a larger proportion than male (93.3%). Mrs. Huda stated that "the IEN platform has played a significant role in lesson preparation in sign language thus the teacher presents them in a timely manner; and the student can repeat the lesson more than once under family supervision".

All male teachers (n=15) used camera, and YouTube clips compared to only eight female teachers. Mr. Fahad said: "I used specific YouTube clips related to the lessons from the diligence of Deaf associations, with high accuracy and are useful for enriching and consolidating information for Deaf students". Again, the differences in using the camera between the genders related to the cultural and religious constraints for women compared to men. Microsoft Teams, Liveworksheets and teaching aids; nevertheless, were used more by female teachers than male teachers with percentages ranging from 60% to 13.3%. Mrs. Enas reported that

> I used Microsoft Teams because students can interact through it, and refer to it later to benefit ... I also used the national platform because it represents an important forum for the teacher with the students and with the school administration.

An interesting point was made by Mr. Samer: "Liveworksheets, Word wall, Microsoft Forms and Padlet were used to teach Arabic and religion to Deaf students, and they're very useful but their effectiveness depends on the families' interaction and follow-up of the lesson with their sons".

The use of certain programs was confined to one gender over the other. All electronic tools in the table were used by female teachers except Telegram and Google duo which were only used by male teachers. Mrs. Najat expressed:

> I used Tarjuman to convert speech into sign language through a three-dimensional drawing, so that students can understand Arabic lessons, but I used WhatsApp to contact the students, outside school time and family or the school administration because their responses are quicker.

Interestingly, Microsoft Teams, 'IEN' platform, teaching aids, camera and YouTube clips were the only programs and tools recommended with emphasis by Mrs. Amal (a Deaf teacher), who indicated that

> I used pictures, illustrative videos, and some teaching aids to explain the lessons through the camera but I cannot completely rely on the lessons of 'IEN' because the indicative translation in all lessons is not suitable for the primary stage, they only do rapid translation, thus that reduces interaction with students.

Although the 'IEN' platform was provided some fulfilling for Deaf students, no sign language was provided for these materials. However, further studies with Deaf teachers are required to investigate the effectiveness of programs used in Deaf students' education.

There is a clear diversity and disparity in the extent to which teachers of both genders use the strategies and tools used during D-learning for Deaf students. This could be attributed to the modernity of D-learning in Saudi schools, which made teachers try to employ many programs and applications in teaching Deaf students and verify their suitability to students' abilities.

The effectiveness of using the strategies and electronic applications and programs by the teachers varies based on different factors: the school stages, subject they taught and family's role and it's following up with their children, the reasons for using the tools, technical problems and teacher's skill and experience in using the program. Therefore, there is a need for more detailed studies on a larger sample of teachers and Deaf students on the effectiveness of such strategies and technological programs with Deaf students during the activation of D-learning, whether during or without crises.

Suggestions for Improving D-Learning for Deaf Students

With regards to the fourth research question, "what are the suggestions for improving the D-learning experience for Deaf students?", most of the participants made a number of suggestions for improving the D-learning process for Deaf students during crises. The following suggestions are grouped into five levels.

At the ministerial level

The importance of having a sign language interpreter during D-learning was stated by 12 teachers.

> Deaf students need sign language interpreters along with the teacher because it's difficult for the teacher to prepare the lesson and explain it in sign language with limited direct engagement with Deaf students and sometimes with no camera; therefore, the Ministry should reconsider the employment of sign interpreters to enhance the D-learning quality for Deaf learners (Mrs. Najat).

Unqualified school administration in the Deaf field may not recognize teachers' needs which lead to inadequate management of the schools' plans. Therefore, Mrs. Sarah suggested: "Assigning supervisors specialized in Deaf education to be aware of Deaf students' needs and to provide solutions that suit them, and not focus on hearing students' requirements only".

At the school level

One of the teachers suggested "reducing the curriculum, focusing only on the important lessons and staying away from some repetitive lessons, especially during crisis, and exploiting the time of D-learning to focus on lessons' basic objectives" (Mrs. Enas).

> During crisis, it's important to focus on important lessons and cut back on extra-curricular activities that require lots of effort from teachers, students, and family … during D-learning, there must be a mechanism for structuring the topics to be brief and focused (Mrs. Manal).

An interesting suggestion was made by Mrs. Amal (a Deaf teacher): "The school administration must provide a sign language interpreter in the parents' meetings during using Microsoft Teams or through attending the meeting, because some parents are Deaf, and in some cases both are Deaf".

The need to develop digital skills for teachers was reported by nine teachers.

> The courses offered to educators do not go in-depth into using technology with Deaf students; most of these courses focused on exhausting topics such as deafness …we need training courses for distance teaching methods of Deaf students and creating visual aids that are commensurate with Deaf students' characteristics (Mrs. Amal, a Deaf teacher).

At the technical level

To successfully function in an entirely virtual environment, Deaf students are required to have the needed computer skills as well as taking online D-learning courses. Computers and good quality Internet services should be available in every class to allow teachers to use the latest and most appropriate technological programs in the process of teaching Deaf students. Mr. Samer suggested that "the 'IEN' platform must be developed so that it has the feature of synchronizing the translation of the voice of the parameter into sign language". Mrs. Hala stated: "There should be organizations that support families of Deaf students by providing them with computers because all my students use their mothers' mobile phones for D-learning".

Also, "there're some families that exchange devices with each other and some do not have any devices, and there should be a free internet subscription in the educational platform and free applications for Deaf students, especially for those with limited income", as recommended by Mr. Adulrahman. Providing continuous technical support for teachers, students and their families during D-learning was recommended by 11 teachers. Also, when providing YouTube videos for Deaf students, they must be translated into sign language, rather than just providing video links, or converting videos to texts, as suggested by McKeown & McKeown (2019).

At the family level

Providing appropriate training for Deaf students and their families was reported by sixteen teachers. Mr. Fahad suggested: "It is important to provide training courses for Deaf students and their families in dealing with the educational platform, the importance of D-learning and learning sign language". Mr. Omar justified this by saying: "some parents, who are not able to use the platform, send their children's assignments to the teacher via WhatsApp".

At the personal level

Four teachers pointed out the importance of safeguarding the psychological health of teachers, Deaf students and their families during the crisis to guarantee the high-quality teaching and well-being of all of them. Mrs. Najat recommended "psychological preparation for students and their families before the beginning of the academic year via providing them with educational and recreational activities remotely along with awareness sessions". In this context, Mrs. Huda suggested

> Developmental courses for the psychology and self-aspect of teachers are necessary during crises to improve their psychological and social status … I attended the effective communication course in D-learning and workshops on self-development, but we still need courses in handling pressures and deal with Deaf students' families.

CONCLUSION

Transition to D-learning because of COVID-19 led Saudi teachers to having a higher workload to ensure Deaf students have an education of similar quality to that during traditional learning. Most teachers; however, reported encountering numerous challenges during the crisis. To address this issue, this study determined the obstacles confronted by teachers using D-learning during the crisis as well as discussed strategies and tools which will assist in overcoming them.

These challenges may be a result of the novelty of D-learning and the swift transition to it or the lack of proper qualification of teachers to teach Deaf students via D-learning. Despite the current study discussing this point to an extent, future research is needed to look into more participants and conduct a deeper examination through a quantitative research method that considers the challenges, tools and strategies which appeared during the study. The study highlighted the major challenges for the teachers in Saudi Arabia:

Administrative, technical, teaching, family and personal challenges as well as explored several educational strategies and tools that teachers adopted as part of D-learning throughout the epidemic.

The study findings will help teachers of Deaf students to develop the teaching methods in D-learning and improve their effectiveness through analyzing their pedagogy. It will also contribute to inform policy and practice and enhance the virtual methods of Deaf learning entirely during the crisis, and to show the support needed by the Saudi Ministry of Education which should be involved in the process. Changes need to occur to incorporate the blended education system into Deaf education. Such changes include, but are not limited to, adding newer contents to reigning policies that recognize Deaf students' needs during pandemics, improve virtual learning applications and platforms to increase their accessibility for Deaf students. Telecommunication and internet services also need to be reviewed and offered to all disabled students to sustain of the educational process during any crises.

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