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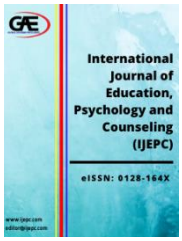

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RELATIONSHIP BETWEEN COMMUNICATION FACTORS AND ACADEMIC ACHIEVEMENT OF DEAF AND HARD OF HEARING STUDENTS IN SAUDI UNIVERSITIES

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Abstract:

The purpose of this study is threefold: 1) to validate the psychometric properties of communication factors' measure, 2) to examine the degree of relationship between communication factors and the academic achievement of deaf and hard of hearing students (DHH) in Saudi universities, and 3) to test the moderating of gender in the relationship between communication factors and the students' achievement. Data were collected from 298 DHH students using a quantitative survey. The study employed co-variance-based SEM using AMOS version 24. To test the psychometric properties for the communication factors, Confirmatory Factor Analysis (CFA) was employed. Second, a full-fledged SEM was conducted to test the relationship between the communication factors and the students' academic achievement. Finally, to examine the moderating role of gender, a multi-group analysis was applied. The results indicated that the multidimensional hypothesized model of communication factors was empirically valid and reliable. The results also revealed a statistically significant relationship between communication factors and the students' academic achievement, $\beta = 0.23$. Besides, the moderating role of students' gender in the relationship between communication factors and the students' academic achievement was also significant. In this regard, the change in the Chi-square was 48.06 while the change in CFIs and the value of the RMSEA were checked against the .001 and .05 cut-off scores respectively. Accordingly, the findings will contribute to increasing knowledge regarding communication factors in higher education programs for DHH students in the Kingdom of Saudi Arabia (KSA). The findings will also be useful to educators and policymakers in the Ministry of Education (MOE) in the field of deafness and hard of hearing. This research also has the potential to positively reflect on

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the performance of Saudi higher education institutions, thus enhancing DHH students' academic achievement.

Keywords:

Academic Achievement, Communication Factors, Deaf students, Hard of Hearing students, Higher Education

Introduction

One of the goals sought by special education programs in many countries is to raise the level of academic efficiency for deaf and hard of hearing students (DHH) in all stages of education, including higher education (Bossaert, Doumen, & Buyse, 2011). DHH students need services and support systems to access information and success in a university environment. More so, they need a high level of communication skills (Al-Bertini, Kelly, & Matchett, 2012). Communication refers to a contact between DHH students, teachers, and hearing students for the purpose of exchanging information (Meranda, 2020). In universities, the role of communication factors for DHH students is undeniable because they depend on a third party to provide access to information (Meranda, 2020; Stinson, Eisenberg, Horn, Larson, Levitt, & Stuckless, 1999). Hence, they need to receive information through interpretation, group study sessions, and informal learning opportunities (Lang, 2002). Therefore, DHH students should work with their university's support service office to obtain equal access as their hearing peers with all the opportunities available (Braun, Clark, Marchut, Solomon, Majocha, Davenport, & Gormally, 2018; Marchut, 2017), especially since the communication abilities of DHH students differ from those of hearing students at universities (Marchut, 2017). The university's support service office helps to take necessary measures to facilitate communication between DHH students and faculty members through meetings at the beginning of each semester (Al-Ajlan, 2017; Al-Rayes & Al-Kharji, 2010; Smith & Andrews, 2015). One-to-one/group sessions and interpreting using sign language in lectures are key factors in communication (Braun et al., 2018; Lang, 2002; Marchut, 2017).

In respect of one-to-one or small group sessions, Marchut's study (2017) revealed that these sessions are very useful for DHH students because such sessions help them to communicate with faculty members and hearing students effectively, and they will have a better understanding of the lectures. In contrast, Brennan, Grimes, and Thoutenhoofd (2008) mentioned that the group lessons are difficult for DHH students because they need to work harder than their hearing peers to achieve similar goals. According to Stinson, Liu, Saur, and Long (1996), the behaviors of hearing peers are one of the biggest challenges that DHH students faced in such sessions and lectures. For example, DHH students cannot follow a lecture when more than one student is talking to discuss a lot of ideas at the same time. Therefore, it is important for faculty members to understand the needs of each DHH student and know the strategies that are most beneficial to them (Braun et al., 2018). Furthermore, Marchut (2017) stressed the importance of watch groups and intervention if needed by instructors.

Regarding the interpreting using sign language, Marschark, Leigh, Sapere, Burnham, Convertino, Stinson, and Noble (2006) revealed that this service one of the most important support factors for DHH students. It is one of the services that is provided inside and outside

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the classroom in some Saudi universities (Al-Rayes & Al-Kharji, 2010). This service, too, helps them have adequate access to information and promote better communication (Al-Ajlan, 2017). According to Hanafy and Al-Aydy (2016), the presence of an interpreter for DHH students in universities helps in improving their quality of academic life. DHH students usually need the support of professional interpreters that are familiar with the requirements of higher education (Da Costa Rocha, 2018; Napier & Barker, 2004). This need is more urgent than ever because it helps the students receive information (Berge & Ytterhus, 2015; Mohammed, 2020). One of the most important roles of interpreters is to facilitate communication between faculty members, classmates, and DHH students by translating spoken language into sign language (Freitas, Delou, Silva Amorim, Melo Teixeira, & Castro, 2017). Therefore, Braun et al. (2018) recommended that it is necessary for interpreters to pass rigorous standards to obtain a certificate proving their ability to translate academically, especially since DHH students prefer to learn through an experienced translator.

Most importantly, the university or department must work to meet the needs of DHH students. For example, DHH students should be allowed to sit in a designated place with clear lines of sight inside the classroom (Braun et al., 2018; Marchut, 2017). Furthermore, interpreters should wear neutral or black colors to avoid distracting DHH students and standing in the front of the rooms (Braun et al., 2018). More so, both faculty and interpreters should work together to encourage DHH students to choose their preferred method of communication, whether it is bilingual, sign language, spoken language, or written language (Mohammed, 2020).

Additionally, interpreters should communicate with faculty members prior to the beginning of the semester to introduce themselves and obtain copies of teaching materials (Al-Rayes, 2008). Interpreters should also attend all lectures and class meetings throughout the semester as this helps them learn vocabulary related to the courses (Freitas et al., 2017). According to Lang (2002), the accuracy and effectiveness of translation are highly dependent on knowledge of the content. This helps the interpreters to reduce translation errors and focus on the lectures. This was confirmed by Berge and Ytterhus (2015) who showed that when interpreters are familiar with specialized vocabulary of a particular discipline, they may be more adept in transferring information to DHH students.

Conceptual Framework

The conceptual framework of this study has been based on the Ginott's Congruent Communication Theory by Ginott and Palmer (1972), and this theory traces back to principles of human psychology that focus on the need for effective communication in the classroom (Charles, 1999). This theory helps to understand the teachers' roles in effective communication and classroom management, as well as the way the teacher interacts with students (Manning & Bucher, 2001; Taylor, 2004). According to Ginott, the teacher stimulates the students by involving everyone in the class to tackle all important issues and respond both verbally and non-verbally (Taylor, 2004).

According to Manning and Bucher (2001), Ginott's communication theory is more applicable to higher levels of education than primary school. This is because students are abler to respond and contribute. Higher education teachers can communicate with their students using effective listening techniques, body language, and facial expressions that correspond to verbal messages. The current study adopted this theory with regard to communication factors because the study explained the communication in study groups at universities between faculty members, DHH

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students, as well as sign language interpreters. Furthermore, this theory helped to explain how various factors, particularly communication factors such as effective communication, congruent communication, and effective classroom management, are likely related to academic achievement of DHH students in universities.

In addition, the conceptual framework of the current study was based on independent and dependent variables, as well as a moderating variable. The independent variable was communication factors, while the dependent variable was academic achievement, measured by the CGPA. Moreover, the researcher used students' gender as a moderator variable in the relationship between communication factors and the academic achievement of DHH students in Saudi universities.

This study focused on the relationship between communication factors and the DHH students' achievement in universities. In fact, previous studies revealed that DHH students reported low satisfaction about communicating with hearing students, especially in lectures and classrooms (Cawthon, Schoffstalll, & Garberoglio, 2014; Marschark, Sarchet, & Trani, 2016). Therefore, it is possible that ineffective communication among DHH students is a contributing factor to the low achievement rate (Cromeenes, 2019; Marschark, Shaver, Nagle, & Newman, 2015). Smith and Andrews (2015) emphasized that there are some strategies that contribute to increasing effective communication, such as opening lines of sight among study group participants, only one person speaks at a time, slowing down the turn in discussions which contributes to student participation, as well as slowing down the pace of the conversation.
Furthermore, several past studies have emphasized the relationship between interpreters and teamwork for DHH students (Chibuike, 2020; Marschark et al., 2006). Other studies have indicated the importance of interpreters in facilitating DHH students' communication and academic success (Chibuike, 2020; Da Costa Rocha, 2018; Marschark et al., 2006). Therefore, faculty members should realize the importance of interpreters in lectures (Mohammed, 2020). In the Saudi context, experts have indicated that there is still a lack of investigation into the moderation effect of students' gender on the relationship between communication factors and academic achievement of DHH students in Saudi universities. In addition, there is a dearth of research on the relationship between communication factors and the DHH academic achievement (Hanafy, 2018). Therefore, more of this type of research is needed.

In short, Figure 1 clarified the model and the relationship between the study's variables. Accordingly, this study aimed to examine the relationship between the independent variable (communication factors) and the dependent variable (academic achievement). Also, this study also aimed to investigate the moderation effect of (students' gender) on relationship between CF and AA.

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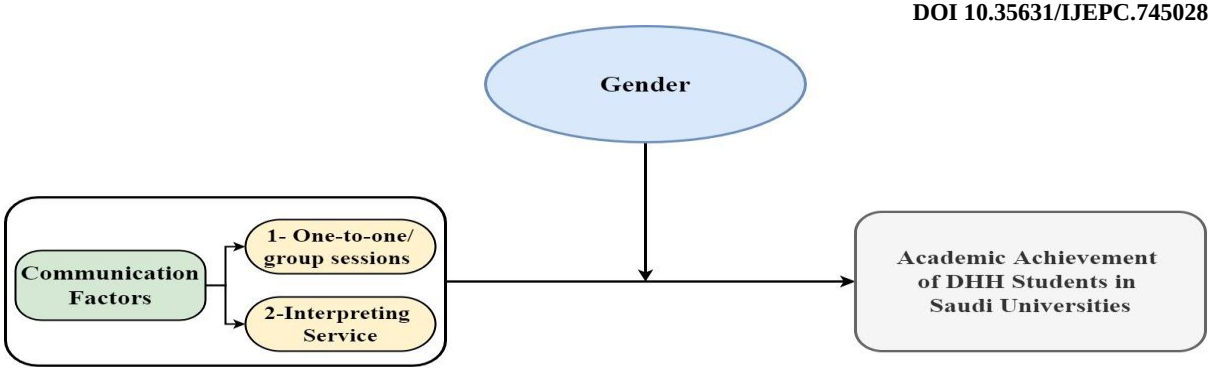

Figure 1: Model of the Study

Literature Review

One of the earliest studies to address 50 DHH students' perceptions about communication in lectures was Stinson et al. (1996). The focus was on support services related to communication and attitudes of faculty members and hearing students in mainstreamed lectures. The most significant finding was the behaviour of their hearing peers. For example, many students tend to talk when discussing ideas at once, which impedes effective communication in lectures. This study also confirmed that students' success in universities depends on their use of effective communication. Moreover, Luckner and Bowen (2006) emphasized that even though DHH students are able to master academic content, their ability to succeed academically is compromised by delays in developing language and communication skills.

Furthermore, Lang, Biser, Mousley, Orlando, and Porter (2004) examined the outcomes of tutoring through one-to-one or group sessions, and tutors' responsibilities through the perceptions of 73 DHH students. The results indicated that there were noticeable differences in perceptions among DHH students. These differences were related to the appropriate way of communicating with tutors during these sessions. Additionally, Hadjikakou, Petridou, & Stylianou (2005) indicated that the DHH students demanded additional hours of one-to-one/group sessions because they could not follow the curriculum.

Regarding the use of sign language in lectures, DHH students also emphasized on several important points related to translators through the study of Napier and Barker (2004). These points include university qualification, educational background, awareness of individual and linguistic needs of DHH students, good skills in the use of both sign language and fingerprint spelling, as well as awareness of individual differences among DHH students.

Based on Fischer's article (2006), 12 DHH students at the Utah University had filed a lawsuit against the university because it failed to provide enough sign language interpreters and a number of other services for them, which deprived them of educational opportunities. According to another study by Safder, Akhtar, Fatima, and Malik (2012), the DHH students also faced many difficulties regarding the shortage of sign language interpreters at the university of the Punjab, Pakistan. They reported that such problems could be reduced by making appropriate arrangements to meet the needs of these students in lectures.

Similarly, the results of a study conducted on two DHH students in Australian universities by Hyde, Punch, Power, Hartley, Neale, and Brennan (2009) confirmed that both of them reported insufficient access to translation services. More so, Kisanga (2020) highlighted that the DHH

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students in Tanzania faced many obstacles, especially inadequacy of sign language interpreters. According to Bamu, De Schauwer, Verstraete, and Van Hove (2017), one of the main challenges that DHH students faced in regular schools in Cameroon was the sign language interpreters' way of working. This is consistent with Adkins' (2020) who stated that the institutions of higher education often do not provide qualified translators with the skills and training needed for academic translation. Thus, teaching by using sign language becomes more difficult when dealing with academic subjects.

The performance of a sign language interpreter is very important for DHH students who use sign language as a basic language of dialogue. This is because it is among the main factors that may affect the academic achievement of DHH students in universities (Mohammed, 2020). Some researchers have suggested that there is a relationship between the role of the sign language interpreters and DHH students' academic success (Berge & Ytterhus, 2015; Freitas et al., 2017; Hrastinski & Wilbur, 2016; Sambu, Otube, & Bunyasi, 2018). Hrastinski and Wilbur (2016) investigated the impact of American Sign Language (ASL) proficiency on the reading comprehension skills and academic achievement of 85 DHH students in the United States. The result indicated that DHH students who were highly proficient in ASL outperformed their less proficient peers in achievement.

Furthermore, the result of Freitas et al. (2017) revealed that the performance of interpreters has direct effects on the academic achievement of DHH students at the Federal Institute of Education in the northern region of Brazil. This is further supported by the results of Sambu et al. (2018) which showed that DHH students' academic achievement improved due to the use of sign language in academic fields. According to Mohammed (2020), the presence of a translator greatly helps in developing the academic aspect of DHH students in higher education institutions.

Liversidge (2003) showed similar trends, which indicated that when providing support factors such as a sign language interpreter, this helps them to raise the academic rate and then continue into the university. Furthermore, Stinson, Elliot, Kelly, and Liu (2009) stressed that one of the most appropriate ways to provide information to DHH students in lectures is through the presence of a sign language interpreter. On the other hand, Berge and Ytterhus' (2015) interview results confirmed that when DHH students at high schools in Norway benefitted from the services of sign language interpreters, their academic achievement would be higher.

In contrast, Marschark et al. (2006) compared the effects of sign language interpreting and other support factors on DHH student learning in lectures. The result was shocking as it showed that the performance of DHH students in all conditions, including with interpreting services was much lower than the performance of their hearing peers. Despite this result, they agreed to the importance of support factors for these students to improve their academic achievement.
In the same vein, Taylor, Callahan, Pinta, Yeatts, and Winiecki (2017) focused on a case study to describe the needs of 11 students at Alpha University, and identify the most important factors that affect their academic achievement. The results showed a low level of academic performance for ten of them. The low communication between the interpreter and DHH students during lectures and the inconsistent performance of the interpreter while interacting with these students were among the main reasons for the low academic achievement.

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Moreover, Meranda (2020) pointed out that there is a common misconception that sign language translation for DHH students in colleges and universities will automatically overcome the achievement gap among DHH students. Even with this service, DHH students in universities receive less information than their hearing peers in lectures (Hyde et al., 2009). This claim is consistent with Marschark et al. (2006) who found that even there were interpreters in Rochester Institute of Technology (RIT), DHH students did not gain as much information from lectures as the hearing students. This might be due to several reasons, and the most important among all is that there are periods when DHH students' eye contact with the translator is interrupted while writing or reading written materials (Mohammed, 2020). Moreover, when the DHH students look at the faculty member while presenting pictures, the students do not have the opportunity to look at the translator at the same time to gauge the importance of those pictures, all of which may force the DHH student to lose part of the information (Da Costa Rocha, 2018; Mohammed, 2020).

After reviewing the literature and based on the conceptual framework, this study aimed to examine the relationship between communication factors (one-to-one/group session and interpreting services) and the academic achievement of DHH students in Saudi universities, as well as the moderating role of DHH students' gender in the relationship between these factors and their achievement. The study also sought to examine the underlying factors of communication factors' construct. **Accordingly, the associated hypotheses are as follows:**

H1: The measure of multidimensional communication factors is valid and reliable.
H2: The communication factors directly and significantly related to the DHH students' academic achievement in Saudi universities.
H3: Students' gender plays a moderating role in the relationship between communication factors and the DHH students' academic achievement in Saudi universities.

Methodology

Population and Sampling Method

The data for this study were collected from Saudi undergraduate DHH students in public and private universities during the second semester of 2019/2020 academic year. These included DHH students who enrolled full-time, whether they were in the first, second, third, or fourth year of bachelor's degree. Information related to the programs was obtained from the MOE. There were only two universities in the Kingdom of Saudi Arabia (KSA) that offer undergraduate programs for DHH students to obtain bachelor's degrees; these were King Saud University (KSU) and Arab Open University (AOU). The total number of male and female DHH students in both universities was 385.

At the time of application of this study, all participants have switched to online learning because the COVID-19 pandemic. Therefore, the researchers cooperated with a deaf person who holds a Master's degree in deaf education to make videos for all items of the online questionnaire by using Saudi Sign Language. DHH students were informed that their identity would not be disclosed and that their information was confidential to achieve the ethical issue. Also, the researchers obtained approval from the MOE in the KSA for data collection.

There were two methods that can be used to determine the size of the sample; first, according to Krejcie and Morgan (1970), the sample size will be 191. Second, based on online Raosoft's

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calculator (2011), the sample size was 298. Researchers decided to distribute questionnaires based on Raosoft calculator due the objectives of this study and the nature of participants, so that they can also obtain adequate data and make appropriate generalizations (Hair, Sarstedt, Hopkins, & Kuppelwieser, 2014).

The present study employed simple random sampling technique to select the targeted participants. The researchers obtained the lists of undergraduate DHH students the administration office in both universities during the 2019/2020 academic year that included (name, matric number, and mobile number). Each student was assigned with a sequential number starting with 1, 2, 3, ...etc. The required sample was generated by a random selection of sequential numbers from the lists because the sampling frame that was used in this study is the random number method. Then, a questionnaire was given by the researcher to every student whose number was selected through mobile messages. For the analysis, a total of 350 questionnaires were distributed. 305 questionnaires were returned, and 7 questionnaires were rejected due to outliers. Finally, there were only 298 usable questionnaires which represents the sample number that was selected.

The Instrument

This study applied the quantitative research design using the survey method of questionnaires. Each questionnaire is divided into two main sections to address the hypotheses that were proposed for the current study. The first section covers the demographic information of the DHH students, i.e., gender, institution, year of study, hearing status, communication method, and actual CGPA. Students' actual CGPA was used to measure the DHH students' academic achievement. DHH students were asked to write their current CGPA which should be between 1 and 5. In KSA, the main grading system used by higher education institutions is out of 5. 0 grading scale. Therefore, it could be seen that the maximum academic achievement presented in the present study was 5.0 while the minimum was 2.15. The mean score of students' academic achievement based on their CGPA was 3.905 and standard deviation was 0.5761.
The second section consists of items covering the communication factors which are divided into two domains: (C1) one-to-one/group sessions and (C2) interpreting services. It contains nine items. Domain (C1) was designed to measure the relationship between one-to-one/group sessions and the academic achievement of DHH students in Saudi universities, which contains four items. Item (1) was adapted from the communication accommodations, IEP/504 Plan (Lovejoy, 2016). The remaining items (2, 3, and 4) were adapted from the teaching and assessment strategies for students with hard of hearing and deafness (McLennan, Hawkeswood, Leahy, Hindle, Kutchel, Geard, Britt, Allan, & Downie, 2014). The second domain (C2) was designed to measure the relationship between interpreting services and the academic achievement of DHH students in Saudi universities. It contains five items. Item (1) was adapted from IEP/504 Plan (Lovejoy, 2016). Items (2) and (3) were adapted from the teaching and assessment strategies (McLennan et al., 2014). Meanwhile, the fourth and fifth items were adapted from the Ohio educational service guidelines for students who are deaf and hard of hearing (Stewart & Crane, 2019).

A five-point Likert scale was used to measure all items for the communication factors' questionnaire, where (1) represents 'strongly disagree' and (5) is 'strongly agree'. In order to achieve the present study's objective, the questionnaires were completed by the undergraduate DHH students. A total of 298 usable questionnaires were received and analyzed using covariance-based structural equation modelling (SEM) via AMOS software (version 24).

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Data Analysis and Results

Preliminary Data Analysis and Data Preparation

For data preparation before the analysis, the researchers used SPSS version 26, while AMOS 24.0 was used to determine the statistical analysis of the collected data and the fit of the study model. The researchers took some important steps to validate this study. First, the researchers gave the first version of the questionnaire to professionals who are experts in special education, and their observations were considered. Second, the original English questionnaire was translated into Arabic because majority of the participants in this study were Arabic speakers. Any errors in the translation of the questionnaire had to be avoided in order to ensure the validity of employing this questionnaire in multiple languages. According to Chua (2016), there are several directions about what language should be used when drafting questionnaire statements.

There are some important rules to employ. For instance, back translation is adopted to ensure that the language use is the same as the participants' mother tongue. For that reason, some efforts were taken to fulfil the questionnaire's back-translation process, including consulting specialized translators with special education backgrounds. Regarding the reliability, the overall Cronbach for the variables was above 0.70, which means a good level of dependability and questionnaire's validity in achieving its goals. In addition, these findings demonstrated that the multiple correlation values for each questionnaire item reflected a reasonable standard of correlation.

Demographic Characteristics

Table 1 below presents the demographic characteristics of the DHH students in Saudi universities who took part in this study. The first characteristic is students' gender. As shown in Table 1, 53.4% of the participants were males while 46.6% were female DHH students. Regarding the universities, 56% were from KSU while 44% came from AOU. About the year of study, results of the study revealed a similar variation between the respondents from each group and there was not a significant difference between the numbers of participants. Regarding the students' hearing status, deaf students are those who have a hearing loss of 70 dB or more, while for the hard of hearing students are those whose hearing loss ranges from 35 to 65 dB (Moorse, 2008). In this study, almost the same number was from each group, with 50.3% deaf and 49.7% hard of hearing. Finally, out of the three methods of communication used by DHH students in Saudi universities, sign language and oral method are the most common.

Table 1: Summary of Demographic Information of Questionnaires Participants

Variable	Group	Percentage %
Gender	Male	53.4
	Female	46.6
Institution Studying in:	King Saud University (KSU)	56.0
	Arab Open University (AOU)	44.0
Year of Study:	First year	26.5
	Second year	23.5
	Third year	24.5
	Fourth year	25.5
Hearing Status:	Deaf	50.3

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	Hard to hearing	49.7
Communication Method:	Saudi sign language	8.1
	Oral method	18.8
	Sign language and oral method	73.2

Note: *N*=298.

SEM was used to validate the measurements of communication factors, as well as investigate the relationship between communication factors (one-to-one/group session and interpreting services) and the academic performance of DHH students in Saudi universities using the AMOS (version 24) model-fitting program. Both the measurement and structural models were used by the researchers to verify the adequacy of this model. The covariance matrix produced from the data was used to estimate the postulated models. As a result, the estimating processes satisfied the underlying statistical distribution theory, giving defensible property estimates. To achieve the study's final goal, multi-group analysis was used to look at the moderating effect of the students' gender.

Analysis Procedures

Measurement Model of Communication Factors

The communication factors' measurement model which can be referred to as confirmatory factor analysis was conducted to examine the construct validity and reliability of the model with two dimensions. This study used a series of indicators that had to be compared to the model fit results to ensure that it was accurate. These included chi-square (X2), degree of freedom, comparative fit index (CFI), Tucker-Lewis index (TLI), and the root-mean-square error of approximation (RMSEA). According to the analysis, chi-square (X2) should have been < .5, RMSEA should have been < .08, and CFI and TLI should have been >.90 (Hair, Black, Babin, & Anderson, 2013; Kline, 2015; Schumacker & Lomax, 2016). By using modification indices, the measurement model for the model of study was revised. Figure 1 reveals that the CFA indicated an acceptable fit with chi-square (X2) = 45.319, degree of freedom (DF) = 26, RMSEA = 0.050, CFI = 0.994, IFI=0994, NFI=.986, and TLI = 0.991.

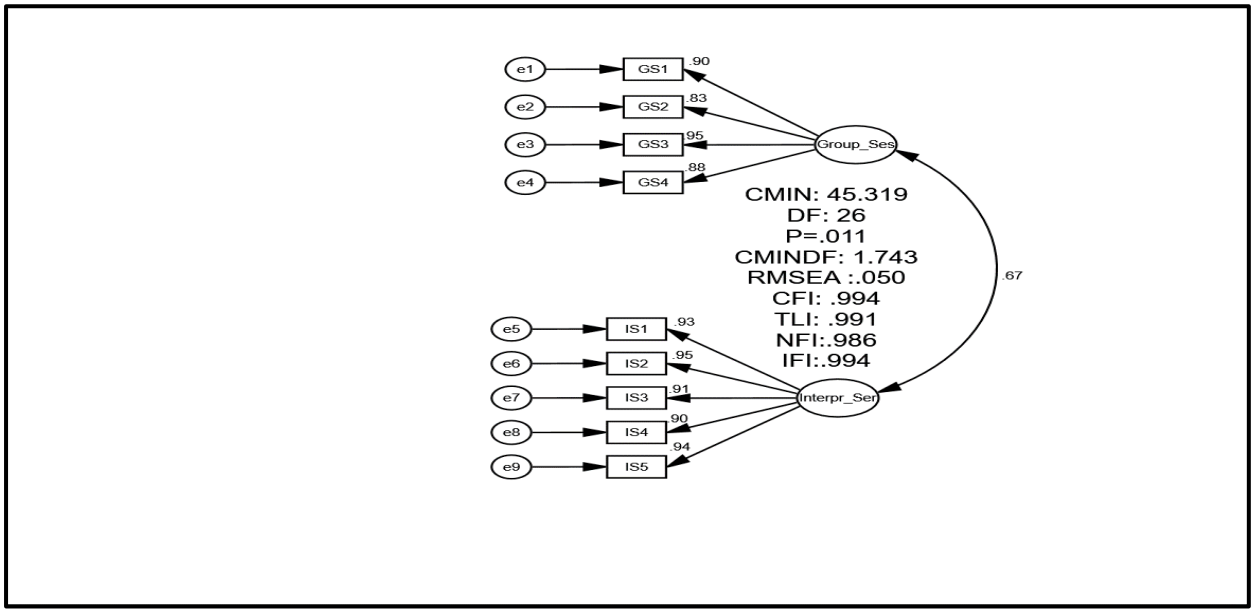

Figure 2: Confirmatory Factor Analysis Results of Communication Factors

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All items are shown in Table 2. This section discusses more evidence for the hypothesized model's validity and suitability as a measurement model for communication aspects. In this section, the measurement model's two types of construct validity: convergent construct validity and divergent construct validity were discussed. The first indicator of this stage was examining all of the elements that revealed all of the loadings as more than 0.70. With an adequate sample size of participants, the factor loadings for the items were acceptable in this scenario. Meanwhile, the average variance extracted (AVE) was above 0.50 and the composite reliability (CR) was above 0.70 (Hair et al., 2014; Byren, 2013 & Kline, 2015). Therefore, all indicators in this study were related to their variables, and there was enough evidence of the measuring model's convergent construct validity. As shown in Figure 1, the correlation between the two dimensions was less than 0.85 in terms of divergent construct validity. As a result, discriminant validity was shown to be valid, and both of these variables in this investigation supported discriminant validity (Hair et al., 2014). The findings indicated that the study model was psychometrically valid in general.

Table 2: Items of the Model

Construct	Item	Loading	AVE	CR
One-to-One/ Group Session	GS3	.949	0.788	0.937
	GS2	.826		
	GS1	.896		
	GS4	.876		
Interpreting Service	IS4	.901	0.856	0.968
	IS3	.906		
	IS2	.950		
	IS1	.926		
	IS5	.943		

Adequacy of the Hypothesized Structural Model

After establishing the study's model's psychometric qualities, the structural model was used to investigate the relationship between communication elements and the academic achievement of DHH students (see Figure 2). The first research hypothesis was addressed in this step. Following the successful construction of the measurement model as the structural model, this phase was deemed the second stage of AMOS analysis. This model's anticipated causal links were consistent with the data (normed chi-square = 1.816; RMSEA = .052; CFI = .991; TLI =.988; NFI=.981, and IFI=.991). All the fit indices for the communication relationship with the academic achievement' model met the recommended levels, which means that the structural model was well-fitted. There were uncorrelated errors for the parameter estimates of the hypothesized model, and the model was free from offending values. The causal structure's route coefficients were statistically significant at the .01 level and displayed practical significance. The standardized path coefficient of communication factors on pupils' academic achievement, $\beta = 0.23$, was significant and statistically significant (see Figure 2).

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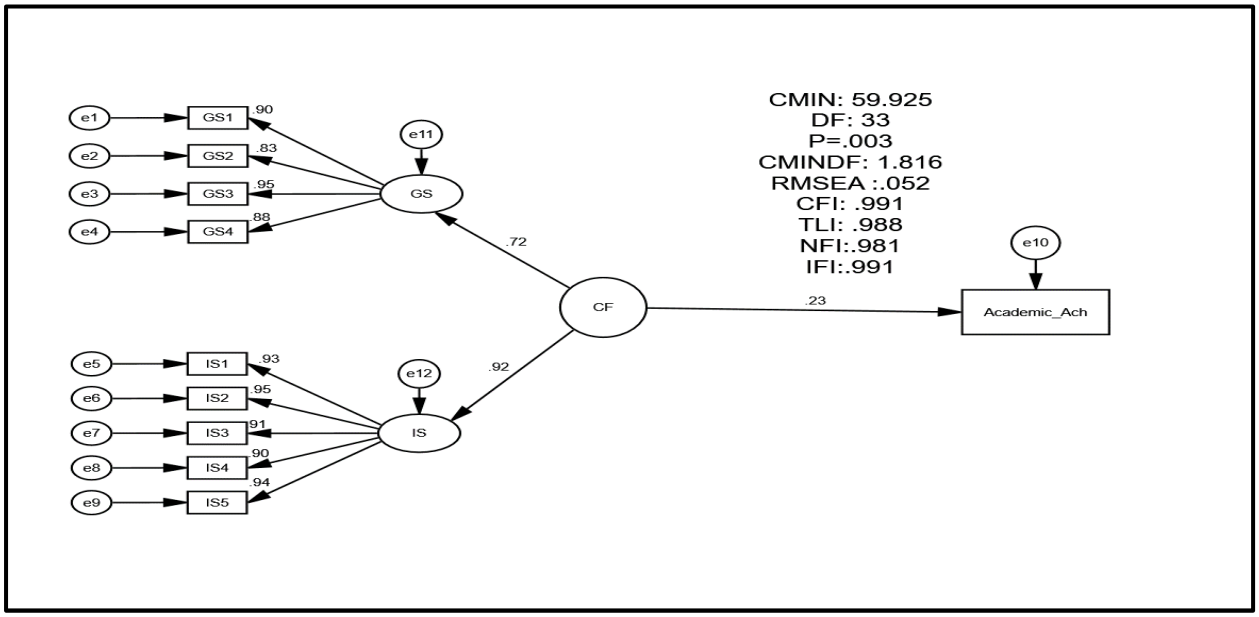

Figure 3: The Structural Model of the Study

Analysis of Students' Gender Moderating Effect

The results of the moderation analysis are shown in Table 3, which supported the third hypothesis in this study about the moderating role of students' gender in the relationship between communication factors and the DHH students' academic achievement at Saudi universities. Another chi-square value was obtained from the estimation of the constrained structural model for the relationship between communication factors and students' academic achievement, which was then compared to the baseline value for statistically significant differences. Lastly, the limited model's change in CFIs and the value of the RMSEA were checked against the .001 and .05 cut-off scores, respectively (Byrne, 2013; Kline, 2015).

Table 3: Results of the Gender-Invariant Analysis

Indices	Unconstrained	Constrained	Change	Decision
Chi-square	181.387	229.402	48.06	Groups are different at the model level; and gender moderates this relationship
Degree of freedom	64	66	2	
CFI	0.965	0.951	0.014	
RMSEA	0.079	0.079	0.000	

The multi-group analysis test for the structural model showed statistically significant change in the chi-square value across the students' gender (male and female). That is, the increase in the chi-square values from the unconstrained model to the constrained model produced a poorer model of the relationship between the moderating role of students' gender in the relationship between communication factors and the academic achievements of DHH students at Saudi universities. In other words, the path coefficient of the male students' group was greater than that of the female students' group (.49 and .31, respectively). Thus, the relationship between communication factors and the academic achievement of DHH students in Saudi universities was greater among male students. Hypothesis (H3) is, for that reason, accepted.

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Discussion

According to the first hypothesis, the results from the measurement model pointed out the evidence of two-dimensional models for the communication factors, thereby immensely expanding the understanding of their existence. Thus, good proof of validity has been presented by the measurement model, which signifies the validity and reliability. As such, the present study provided empirical evidence that the communication factors are a multidimensional construct, as implicitly hinted in earlier works (Hadjikakou et al., 2005; Lang, 2002; McLennan et al., 2014; Stewart & Crane, 2019).

In line with the second hypothesis, the results of the structural model found that communication factors related to the academic achievement of DHH students in Saudi universities. This result supports our hypothesis that communication factors (one-to-one/group session and interpreting services) are a significant predictor of DHH students' academic achievement in Saudi universities. This indicates that providing and using communication factors resulted in an improvement of DHH students' academic achievement in higher education. Therefore, they are likely to perform positively when they have better communication services. This means that communication factors should be provided by university program administrators to increase the chances of success among DHH students. This finding is supported by the results of the previous studies which have indicated the importance of communication factors, whether they are group sessions or interpreting services in raising the academic achievement and affecting the learning outcomes of DHH students (Berge & Ytterhus, 2015; Freitas et al., 2017; Hadjikakou et al., 2005; Hrastinski & Wilbur, 2016; Lang et al., 2004; Mohammed, 2020; Sambu et al., 2018).

In contrast, this result contradicts with the result of other previous studies (Brennan et al., 2008; Marshark et al., 2006; Stinson, Elliot, & Kelly, 2017; Stinson, Stinson, Elliot, & Kelly, 2004), which indicated that the performance of DHH students with interpreting services and in all conditions was much lower than the performance of their hearing peers. More so, previous research showed that the DHH students prefer to use technological devices during lectures such as real time captioning and C-Print because they provide a permanent record that the DHH students can review after class to remember relevant information (Al-Salamah, 2020; Stinson et al., 2004; Stinson et al., 2017).

According to the third hypothesis, the multi-group analysis test for the structural model showed statistically significant change in the chi-square value across the male and female students. Accordingly, this result supports the researchers' hypothesis that the gender affected the relationships between communication factors (one-to-one/group session and interpreting services) and the students' academic achievement in Saudi universities. The results concerning the moderating effect of students' gender shows that gender has a moderating effect on this study relationship. In other words, there were differences between males and females DHH students in their perspectives toward this relationship in favor of male students, which means that the effect is greater among male DHH students. It appears that male DHH students were more inclined to acknowledge the influence and relationship of communication factors to their academic achievement, and they are likely to perform positively when they have better communication. In fact, no study has ever investigated the moderating effect of gender in the relationship between communication factors and the academic achievement of DHH students in Saudi universities. However, the results related to the students' gender in this study correspond slightly with Al-Qahtani and Hanafy (2015), which confirmed the existence of

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statistically significant differences in the opinions of DHH students in the middle school in Al-Ahsa city in the KSA, in their perception of the reality of the support services provided to them according to the gender in favor of males.

Based on the above discussion, it can be summarized that the provision and use of communication services can lead to an increase in the academic achievement rate for DHH students in Saudi universities. In other words, the DHH students are likely to put forth their best in their studies and achieve better academically when they have better communication during their study. In fact, the current study aimed to generate essential data in the field of communication and DHH students' achievement, as there is a lack of studies focusing on the relationship between communication factors and the academic achievement, particularly among DHH students. Also, the investigation of the gender as a moderating variable is important additional information to the Saudi literature in the field.

Limitations

The limitations of the current study were the time period of application of this study which was in the phase of COVID-19. It was difficult to reach DHH students due to this condition. The response of DHH students was low even though best efforts were made to gather adequate responses. Meanwhile, the researchers were only able to obtain the required number of responses from the study sample after the repeated attempts. It was difficult to get responses on time even with translating the questionnaire's items into Saudi sign language. Therefore, random numbers for DHH students were chosen more than once to reach the required number of responses from the study sample. Furthermore, these results cannot be generalized to other special education categories because the services provided to them differ from the services provided to DHH students in Saudi universities. Finally, the research has been written in English, although the subjects are Saudis who are well-versed in Arabic.

Implications and Recommendations

There are many practical implications that should be considered. Firstly, the current study verified the validity of the communication factors' questionnaire and highlighted the importance of these factors in raising the success rates, as well as facing challenges related to the integration of DHH students in the higher education sector. Therefore, higher education institutions can use the model proposed as a validated model in planning and creating more programs for DHH students. Secondly, the findings of this study provide evidence for the MOE and higher education institutions about successful adoption of communication factors and its relationship with academic achievement of DHH students in both universities and general education. Thirdly, this study provides practical support for the moderating role of gender. To the best of the researchers' knowledge, this study is the first attempt to test the moderating effect of DHH students' gender on the relationship between communication factors and the DHH students' academic achievement in Saudi universities.

Furthermore, policymakers and program managers can use the results of the study as a guideline in organizing higher education programs for DHH students in Saudi universities and colleges and to develop effective plans to achieve desired long-term goals. Moreover, the findings will help expand the scope of provided communication factors to achieve the higher education goals. More so, this study sheds light on the factors that university administrations need to focus on in order to contribute to higher student enrolment rates and to improve the quality of education and achievement.

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Additionally, as communication factors are one of the important factors in determining the achievement of DHH students in universities, these factors should be provided and used by practitioners, educational and administrative staff, and faculty members to reach the desired educational goals. Thus, it is important for universities managements to focus on organizing and preparing programs by providing the necessary communication factors, providing DHH students with instructions and directions related to these factors, and conducting evaluations for the programs.

In addition, the university's support service office should provide the necessary communication factors to DHH students as well as instructions and guidance that relate to these factors such as group session and sign language interpreters. Besides that, faculty members should provide individual and group sessions to students with HI to ensure understanding of the learning materials. Also, clear procedures for working should be set among the general supervisor, supervisors of support units, faculty members, and sign language interpreters. Finally, the findings and recommendations of the current study should receive attention from the MOE, decision-makers, policymakers, faculty members, and sign language interpreters because they are all responsible for developing higher education programs for DHH students in Saudi universities.

Conclusion

Issues related to the academic achievement of DHH students are among the most important topics addressed by researchers in the field of special education (Crowe, Marschark, Dammeyer, & Lehane, 2017). It is a major area of research in university education (Hrastinski & Wilbur, 2016). Therefore, it is important to investigate the factors that related to the DHH students' academic achievement in higher education institutions in order to overcome difficulties and solve problems. Accordingly, this study was prepared to examine the relationship between communication factors and the academic achievement of DHH students in Saudi universities, taking into account the moderating effect of DHH students' gender on the relationship between these factors and the academic achievement.

The findings confirmed that there is a direct significant positive relationship between communication factors and the academic achievement of these students. Therefore, communication factors have an important role in enabling DHH students to achieve a high rate of educational achievement. Another important result is the revelation of a moderating effect of students' gender on the relationship between communication factors and achievement. Accordingly, there was an indirect relationship between communication factors and DHH student achievement through students' gender in Saudi universities for male students. This means that the effect of communication factors on DHH students' academic achievements in Saudi universities was greater among male students.

In fact, researchers can explore similar fields from different perspectives because the current study was limited to the selected universities. Therefore, they can investigate the same variables in colleges that offer diploma programs or in the general education sector to reach more general conclusions. Furthermore, mixed method studies can be conducted to provide stronger conclusions. Also, it would be possible to conduct a similar study for other categories of students with disabilities such as blind students and students with learning disabilities. Moreover, there is a need to explore other demographic variables as moderators and determine

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whether they have a role in the relationship between communication factors and the academic achievement of DHH students. Finally, it is possible to conduct comparative studies in comparing higher education programs for DHH students in Saudi universities with higher education programs in other countries.

On the Saudi side, Hanafy and Al-Saleh (2018) indicated that the academic achievement of DHH students is affected by a number of communication factors such as interpreting services using sign language. According to Al-Rayes and Al-Kharji (2010), the DHH students faced challenges related with inadequacy of sign language interpreters in higher education programs in Riyadh, and such challenges affect them academically (Mohammed, 2020). To overcome these challenges in the KSA, many previous studies recommended the importance of providing appropriate support factors to the needs of DHH students, and the most important are expert sign language interpreters (Hanafy & Al-Saleh, 2018). Da Costa Rocha (2018) also emphasized the need to provide professional sign language interpreters in universities, especially those with advanced levels of language proficiency. Napier and Barker (2004) also stressed the need for translation educational background, and working towards preparing and training them for academic scientific translation to work within the university context (Al-Rayes, 2008).

In summary, communication factors play a crucial role in the academic success of DHH students in Saudi universities. Therefore, there is an urgent need to explore the relationship between communication factors and the academic achievement of DHH students in universities by looking at the current situation. More research will definitely provide valuable evidence in improving DHH students' higher education programs. Lastly, it is hoped that the current study will inspire future researchers to seek for more important factors that could raise the rate of success among DHH students in higher education.

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