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Research Article

Language And Math Skills Among Post-Secondary Deaf Students

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ABSTRACT

The current study aimed to identify the level of language and math skills among deaf people who completed secondary education and compare them with those of hearing people in the school stage from the second to the seventh grade. To achieve the objectives of the study, two tests were designed, the first for linguistic skills (written expression and reading comprehension) and the second for math skills (math operations). Basic, first-degree equations (volume, area, angles, and units). Validity implications were extracted using content validity and discriminant validity of the two tests, as the two tests were able to distinguish between the age levels of the participants (by grade) and distinguish between hearing students and deaf students. Reliability coefficients also extracted using Cronbach's Alpha. The study conducted to a purposive sample of 155 people, including 45 deaf people who completed high school and 110 hearing people from grades 2-7 of both gender (male & female).
The results showed that the level of deaf people in language skills is equivalent to students in the second grade, and that their level in math skills is equivalent to the fifth grade. The results also indicated that there is a statistically significant difference in language skills among deaf people in favor of females, and that there are no statistically significant differences in the level of math skills among deaf people according to the gender variable.

Keywords: *Deaf, education achievement, literacy, reading, writing math, and inclusion.*

Introduction and Literature review:

Deaf education in several centuries and has witnessed significant developments in approaches, philosophies, and educational practices. Early Perspectives: Historically, Deaf individuals often marginalized and excluded from formal education. However, in the 16th century, notable efforts made to educate deaf individuals using *rudimentary manual* methods (Marschark, 2012). In the 18th century, the recognition and development of *Sign languages* provided a breakthrough in deaf education that paved the way for the establishment of formal schools for the deaf, where sign language used as a primary mode of instruction (Van Cleve, 1985). In the late 19th and early 20th centuries, the *Oralism* movement gained prominence, advocating for the use of speech and lip-reading as the primary means of communication and instruction for deaf students. This period witnessed a decline in the use of sign language in educational settings (Lane, 1992). In the mid-20th century, the *Total Communication* approach emerged, emphasizing the use of multiple communication modalities, including sign language, speech, lip reading, and written language. This approach aimed to provide deaf students with a comprehensive communication system. Finally, in the latter half of the 20th century saw the rise of the *Bilingual-Bicultural* approach, which recognizes the importance of deaf individuals' visual-spatial language

(e.g., sign language) and their cultural identity. This approach promotes the use of sign language alongside written/spoken language, fostering bilingual and bicultural (Marschark, 2012).
Teaching deaf student started in *isolation setting*, were deaf student learn in special school. However, in recent decades, there has been a push for *inclusive education*, which integrate deaf students into mainstream classrooms. This movement emphasizes equal access to education and the provision of appropriate support and accommodations for deaf students in regular educational settings (Marschark, 2012).Inclusive education is increasingly recognized as a fundamental human right, and countries worldwide are implementing it, albeit with some policy variations (Desalegn, Worku, 2016).
In Kingdom of Saudi Arabia KSA, the first formal education for deaf began in 1964, in Riyadh city; at Al-Amal (Hope) Institute (Abushaira et al., 2017; Hakeem, 2012). It moved toward inclusion education for deaf in 1990s in the past centaury((Turki, 2005). It expected of this movement to made improvement deaf students literacy achievement. However, deaf students' literacy achievement it still debatable. Moreover, there is no agreement about its improvement.

Research have consistently shown that deaf students face challenges in achieving proficiency in reading and writing skills, resulting in lower educational attainment compared to their hearing peers (Salkić & Povlakić, 2022; Dammeyer, 2014; Sebal & Luckner, 2005; Dyer et al., 2003; Marschark et al., 2002; Budensiek, 1988, and Allen, 1986). The literature review reveals significant gaps in reading proficiency between deaf and hearing students, indicating lower levels of achievement among deaf students (Salkić & Povlakić, 2022; Johnson et al., 2011 & Allen, 1986). These disparities can referred to difficulties in phonological processing, vocabulary development, and reading comprehension (John and Sylod, 2013). The incomplete language development of deaf children also decreases their capacity to comprehend the motivations and actions of others (Carrington and Robinson, 2006).
Similar, deaf students often face challenges in math achievement. Studies shown that deaf students may have difficulties with mathematical problem-solving, conceptual understanding, and mathematical reasoning (Qi & Mitchell, 2012). Factors such as limited exposure to mathematical language and concepts, as well as communication barriers, can affect their mathematical achievement levels.
Research has indicated that the math skills level of deaf students upon completion of secondary school does not exceed the fourth-grade level (Salkić & Povlakić, 2022; Akamatsu, Mayer and Farrelly, 2005).
This gape may refer to Absence of resources centers in almost all public schools, lack off sign language skill among all classroom teachers, awareness gap among staff and teachers and less collaboration and commitment among stakeholders to implement integration policy considered as a key challenges for faced deaf students that prevent benefit from the inclusion (Desalegn, Worku, 2016)

Previous studies:
Alkahtani (2022) studied reading comprehension skills of deaf and hard of hearing students in the qualifying year program and their relationship to some variables. The study applied among (99) deaf and hard of hearing students: (40) males and (59) females' students. He used the descriptive analytical method. The study proceeded author prepared reading comprehension. The results indicated: The performance of deaf and hard of hearing students at the levels of reading comprehension came in the following order: direct comprehension, then deductive comprehension, then critic, and finally creative comprehension. There are no statistically significant differences at the level (0.05) and less about the level of reading comprehension skills according to the gender variable. There are statistically significant differences at level (0.01) and less about the level of reading comprehension skills according to the variable of hearing loss in favor of the hard of hearing category. There are no statistically significant differences at level (0.05) and less about the level of reading comprehension skills according to the variable of the father's educational status. There are statistically significant differences at level (0.05) and less about the level of reading comprehension skills according to the variable of the auditory state of the father who is hard of hearing, and the auditory state "hearing, deaf" in favor of the auditory case "hearing, deaf". There are statistically significant differences at level (0.01) and less about the level of reading comprehension skills according to the age variable between (18-20) years, and between more than (20) years and above, in favor of the younger group of 18-20 years.
Salkić and Povlakić (2022) conducted a study on the usage, reading, writing, and comprehension of the adverbial clause of place in deaf children. The study involved 140 participants, with 70 deaf students in the experimental group and 70 hearing students in the control group, all of the same age. The researchers used a test to assess writing and comprehension skills related to the adverbial clause of place. The findings showed differences between deaf and hearing subjects. Only 1.40% of deaf children were completely successful in reading and writing the adverbial clause of place, while 90% of them used it partially successfully. Approximately 8.60% of deaf children did not use the adverbial clause of place in any form in their written communication. The most frequently used adverbial clause of place among deaf children was "in," followed by "on," "below," "behind," "next to," and "between." The study also found a statistically significant difference in the use of the adverbial clause of place between deaf and hearing children (p=0.000).
Desalegn, Worku, (2016) Integration of students with hearing impaired students come as an education policy in Ethiopia so that long tends of exclusion of deaf students from school get solved. Important logic behind

integration was not only academic benefit but also development of social relation of students with hearing impaired and social isolation get blocked. However, scholars have no common argument regarding joining both hearing- and hearing-impaired students together in one class. Accordingly, based on this review of the recent literatures, social benefit is weighing more than academic benefit for hearing impaired students in integrated class. Absence of resources centers in almost all public schools, lack off sign language skill among all classroom teachers, awareness gap among staff and teachers and less collaboration and commitment among stakeholders to implement integration policy considered as a key challenge for hearing impaired students not to benefit from the integration policy.

Oppong & Fobi (2016) analyzed gender differences in Mathematics achievement of Deaf students in Ashanti School for the Deaf on the Ghana National Education Assessment Test for Primary Six (NEA-P6) in order to provide empirical information for educational practice in that school. Out of a population of 29 Primary Six students, a sample of 16 matched students (8 males and 8 females) aged 14 to 19 years with an average pure tone air conduction hearing loss of 101dB, participated in the study. A t-test for dependent samples used to determine the mean differences between the two group means because the study involved matched participants chosen from a single population.

Kyle, Cain (2015). Present a comparison of deaf and normally hearing readers' profiles on a commonly used reading comprehension assessment into 3 types: literal questions; local cohesion questions; and global coherence questions. Deaf children were matched to 3 groups of hearing children: chronological age-matched controls; reading-age-matched controls; and a group of poor comprehenders. Results: Deaf children had significantly weaker reading comprehension skills than both chronological age- and reading age- matched controls, but their skills were commensurate with poor comprehends. All groups found it easier to make inferences to establish local cohesion than those required to establish global coherence.

Antia, Jones, Reed, & Kreimeye. (2009). Studied reading, writing achievement for 197 deaf or hard-of-hearing students who attended general education classes for 2 or more hours per day. Results on standardized achievement tests indicated that, over the 5-year period, 63%-79% of students scored in the average or above-average range in math, 48%-68% in reading, and 55%-76% in language/writing. The standardized test scores for the group were, on average, half an SD below hearing norms. Average student progress in each subject area was consistent with or better than that made by the norm group of hearing students, and 79%-81% of students made one or more year's progress annually. Teachers rated 69%-81% of students as average or above average in academic competence over the 5 years. The teacher's ratings also indicated that 89% of students made average or above-average progress. Students' expressive and receptive communication, classroom participation, communication mode, and parental participation in school were significantly, but moderately, related to academic outcomes.

Antia, Reed, & Kreimeyer. (2005). collected data from 110 deaf or hard-of-hearing students in public schools who participated in the spontaneous writing section of the Test of Written Language. On average, the students' written quotient fell in the below-average range, but it was within 1 standard deviation of the test mean. Forty-nine percent of the students scored within or above the average range in their written quotient. The mean scores for the three subtests of contextual conventions, contextual language, and story construction were in the low-average range. Between 55% and 68% of students scored within the average or above-average range in these subtests.

In a study conducted by Dyer et al. (2003), the researchers examined how phonological awareness and decoding (PAD) as well as rapid automatized naming (RAN) of visual material are related to reading delay in a group of deaf students (N = 49, average age 13 years) whose reading age (RA) was approximately 7 years. The study found that the performance of the deaf students in PAD was not as strong as that of hearing controls with a similar RA, but it still showed a correlation with their RA. On the other hand, RAN, whether tested in sign language or spoken language, was significantly faster in the deaf group compared to the hearing controls with a similar RA. However, RAN did not demonstrate a direct relationship with reading level or reading delay. Based on these findings, the researchers concluded that while PAD plays a role in both deaf and hearing students' reading achievement, RAN may only have an indirect association with reading in deaf students.

Study terms:

Deaf students: students who use sign language in communication in computer science program in applied collage – Tabuk University.

Language skills: most common sills used in spoken language that students learn in schools. This study focused on reading comprehension and writing expression.

Math skills

Study problem:

In kingdom of Saudi Arabia KSA, the first formal education for deaf began in 1964, in Riyadh city; at Al-Amal (Hope) Institute (Abushaira et al., 2017; Hakeem, 2012), which conceder as isolation setting. Considering that previous studies highlighting the lower academic performance of deaf students compared to their hearing peers were conducted within the context of special education settings (isolation) in schools for the deaf. This study

aims to examine the anticipated changes in the achievement levels of deaf students during the integration period that began in the mid-nineties., so the study tries to answer the following main questions:

1. What is the means of language and math skills of post-secondary deaf students (PSD) and hearing students from G2-G7?
2. Are there statistically significant differences at level $\alpha \leq 0.05$between performances in language and math skills of (PSD) and hearing students (G2-G7)?
3. Are there any statistical differences at level $\alpha \leq 0.05$, in language and math skills among DPS according to gender variable?

Study justification

After decades of inclusive education of deaf student, deaf literacy achievement still questionable, is there any improvement? Moreover, if there are improvement, can we refer it to inclusive education? Therefore, we try to investigate these two questions by conducting this study.

Methodology

Study tool:

A test developed to assess language and math skills, which are essential skills for school students. The language tested by *written expression* and *reading comprehension*. In terms of mathematics, the test included questions on *basic math operations* (+, -, X, ÷), *area & volume*, *angles*, and *first-degree equations*, and *unites exchanges*. The exam was reviewed, so the final copy it cosseted of 3 parts: 1st: *The demographic information* for the participants, 2nd: *language skills* with 2 sup tests: A. Writing expression. It contains three pictures that participants asked to give writing description for it, the participant take one point if he/she write at least one sentence with two words in correct structure and has full meaning. B. Reading comprehension. It contains 15 sentences that have blank between words, participants asked to select one of three words to fill the blank to give full meaning of sentences. Therefore, he/she can get a point for every correct selection. In addition. The total score for language skills= 18. 3rd part was math skill: A. Basic math operations: 13 points as one point for every correct answer, B. Area, volume: participant must calculate volume or the area of shape: 6 points as one point for every correct answer, C. Angles: 3 points, as one point for every correct answer, D. First-degree equations: 4 points as one point for every correct answer, and E. Unit exchange: 4 points as one point for every correct answer. Total score for math skills = 27

Validation

Validation was conducted for two tests as: 1st. content validity which gained by reviewing language skills test and math skills test by educators of student who are deaf, and we have taken all there notes, and 2nd. We conducted discrimination validity for the two tests: language skills test and math skills test as following:
Scores were ranged ascending then divided into two groups (low group and high group with 27.1% total participants (42 individual) for each group (Kumar, 2021). After that, means and standard deviation conducted for two groups as in table 1.

Table1. Means and standard deviation.

	Group discrimination	N	Mean	Std. Deviation	Std. Error Mean
Language	low group	42	7.3571	1.97325	.30448
	high group	42	17.5000	.50606	.07809
math	low group	42	5.5238	2.83908	.43808
	high group	42	23.3810	1.89932	.29307

The results in table 1 indicate that there are differences in the means of participant's performance in both language skills and math skills tests. To ensure the statistical differences between the two groups for language skills and math skills tests at level $\alpha \leq 0.05$, T- test for independent groups proceeds as in table 2.

Table 2. T- Test for independent groups

	t-test for Equality of Means						
	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference Lower	Upper
Language	-32.268-	82	.000	-10.14286-	.31433	-10.7681-	-9.51755-
math	-33.88-	82	.000	-17.85714-	.52707	-18.9056-	-16.80863-

In table 2 P *values = (0.00)* which revels statistical differences between the two groups for language and math tests, that's indicate the two tests can discriminate the two groups (low score group – high score group).

Reliability

Reliability conducted for language skills and math skills tests by Cronbach's Alpha as in table 3.

Table3. Cronbach's Alpha

	Cronbach's Alpha	N
language	.876	18
Math	.926	27

Study sample.

The study participants were 155 students. They were 45 post-secondary individuals who are deaf (22 male, 23 female) and 110 hearing students: 70 males of them from (4-7 grade) and 40 females from in Tabuk city, Saudi Arabia.

Table 4. Participants

Count=155					
			Gender		
Hearing status			Male	Female	Total
deaf	class	post secondary	22	23	45
	Total		22	23	45
hearing	class	G2	11	0	11
		G3	10	10	20
		G4	10	10	20
		G5	13	10	23
		G6	9	10	19
		G7	17	0	17
	Total		70	40	110

Results

To answer the 1st question: What is the level of language and math skills of post-secondary deaf students (PSD) and hearing students from G2-G7? To answer this question we calculate the means of participant's performances in all aspects of language math skills according to their performance on the two tests: as in tale 5.

Table. 5. Language and math skills means and Std. Deviation for participants

class		Total Language	Total math
G2	Mean	10.73	3.00
	N	11.00	11.00
	Std. Deviation	3.29	3.03
G3	Mean	13.50	7.95
	N	20.00	20.00
	Std. Deviation	4.81	2.35
G4	Mean	15.35	11.75
	N	20.00	20.00
	Std. Deviation	2.48	4.73
G5	Mean	15.39	17.00
	N	23.00	23.00
	Std. Deviation	3.19	3.98
G6	Mean	17.16	23.21
	N	19.00	19.00
	Std. Deviation	0.83	2.53
HG7	Mean	15.76	21.12
	N	17.00	17.00
	Std. Deviation	2.36	4.28
DPS	Mean	9.71	16.00
	N	45.00	45.00
	Std. Deviation	3.52	6.21

The results indicate that there are differences in the average performance of deaf students in language skills, which are lower than all levels of hearing students from the G2 to G7. It also clear differences in the average performance of deaf students compared to hearing students in math skills, as the performance of deaf students was higher than the performance of students in the G2-G4, but lower than the average performance of hearing students G5-G7.

To answer the 2nd question: Are there Statistically significant differences at level $\alpha \leq 0.05$between performances in language and math skills of (PSD) and hearing students(G2-G7) an independent samples t-test was conducted to compare the performance of deaf students with hearing students in grades from second to seventh grade, as in the following table3.

Table 6. T-test for mean of dependent groups.

Compartments		t-test for Equality of Means						
		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
							Lower	Upper
G2-DPS	Total Language	0.87	54	0.39	1.02	1.17	-1.32958-	3.36
	Total math	-6.717-	54	0.00	-13.0000-	1.94	-16.88031-	-9.11969-
G3-DPS	Total Language	3.57	63	0.00	3.79	1.06	1.67	5.91
	Total math	-5.602-	63	0.00	-8.05000-	1.44	-10.92135-	-5.17865-
G4-DPS	Total Language	6.47	63	0.00	5.64	0.87	3.90	7.38
	Total math	-2.725-	63	0.01	-4.25000-	1.56	-7.36660-	-1.13340-
G5-DPS	Total Language	6.49	66	0.00	5.68	0.87	3.93	7.43
	Total math	0.70	66	0.49	1.00	1.43	-1.84797-	3.85
G6-DPS	Total Language	9.08	62	0.00	7.45	0.82	5.81	9.09
	Total math	4.88	62	0.00	7.21	1.48	4.25	10.17
G7-DPS	Total Language	6.54	60	0.00	6.05	0.93	4.20	7.91
	Total math	3.12	60	0.00	5.12	1.64	1.84	8.40

The results in table 6 reveled that there was no statistically significant difference between DPS and HG2 in language skills. That, PSD are equivalent hearing student in G2 in language skills. Moreover the results indicated statistically significant difference between DPS and HG3 – HG7 in favor hearing students in G3-G7. In math skills results indicates there are statistically significant difference at level $\alpha \leq 0.05$ between DPS and hearing student in G2-G4 in favor DPS. Moreover, results indicated there were no statistically significant difference at level $\alpha \leq 0.05$ between DPS and hearing student in G5, That, PSD are equivalent hearing student at G5. Also the results reveled statistically significant difference at level $\alpha \leq 0.05$ between DPS and hearing student G6-G7 in favor G6-G7.

To answer the third question: Are there any statistical differences at level $\alpha \leq 0.05$, in language and math skills among DPS according to gender variable?

? Means and Std. Deviation of DPS's performances conducted as in table 5.

Table 7. Means and Std. Deviation of DPS's performances.

	gender	N	Mean	Std. Deviation	Std. Error Mean
Total Language	male	22	.3273	.15622	.03331
	female	23	.5174	.28795	.06004
Total math	male	22	.4428	.21841	.04657
	female	23	.5098	.24506	.05110

The results in table7 indicated that there are differences in the average performance of deaf students in language and math skills between deaf student according gender variable (male and female). To determine whether the differences were statistically significant differences at the level of $\alpha \leq 0.05$, an independent samples t-test was conducted to compare the performance of deaf students according to gender variable (male and female) as in table 7.

Table 7. T-test for mean of dependent groups.

	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
Total Language	-2.735-	43	.009	-.19012-	.06952	-.33031-	-.04992-
Total math	-.965-	43	.340	-.06692-	.06931	-.20671-	.07286

The results in table 7 reveled that there was statistically significant difference between DPS the level of $\alpha \leq 0.05$ according to gender variable in language skills in favor female, in additional there was statistically significant difference between DPS the level of $\alpha \leq 0.05$ according gender variable in math skills.

Discussion

The study results indicated that the language skills of the DPS are equivalent to the skills of the hearing student at G2, which is lower than 10 years of hearing students. This result agree with Katowice (2020); Kyle, Cain (2015), Antia et al (2008); Gilbertson & Ferrewhile (2008), Stephanie ,(2008), Gibbs, (2004) , and Dyer, et al (2003) who revealed that language delay among deaf student about 7 years in compared of hearing peers. These results assert the reading and writing skills gap between deaf and hearing students has not decreased for over past three decades (full inclusion era) Kotowicz (2020).

In math skills, study results tell DPS are equivalent to the skills of the hearing students at G5. This result is lower than 7 years of hearing students. That defer other studies results, which tell that math skills among deaf students are not exceed the fourth-grade level (Salkić & Povlakić, 2022; Akamatsu, Mayer and Farrelly, 2005)

In addition, results indicated there is a statistically significant difference in language skills according gender favor females deaf, this result agree with Oppong & Fobi (2016) study, which indicated the statistically significant difference in deaf student's literacy skills according to gender variable favor female. However, the results disagree with Alkahtani (2022) who stated there is no statistically significant difference in deaf student's literacy skills according to gender variable. In additional study result there is no statistically significant difference in math skills according to gender variable this result agrees with Alkahtani (2022).

Recommendation:

The result of study highlights again the efficiency academic skills for deaf students in inclusion settings and if inclusion arrangement built on evidence base practice. Therefore, it is important to conduct studies to review inclusion educational process, and inclusion educational efficiency.

Study limitations.

The limitations of the study are evident in various aspects, including the study tools used for assessing language and math skills, the psychometric parameters of these tools, the specific skills chosen for evaluation, as well as the characteristics of the participants involved in the study.

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