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# Participatory Communication Methods to Demonstrate Mastery of Mathematical Skills of Algebra and Geometry for Pupils with Hearing Impairment at Higher Secondary Level in Punjab: A Survey Study

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***Abstract*:** This study was conducted with the goal of identifying participatory communication methods employed by special education teachers for demonstrating mastery of mathematical skills of algebra and geometry to pupils with moderate hearing impairment (H.I.) at higher secondary level in Punjab, Pakistan. Special education teachers teaching to pupils with hearing impairment in the special education institutions of the Punjab province made up the population of the study. Convenience sampling technique was used to choose the sample of the sixty special education teachers. The researcher collected data by using a structured self-developed questionnaire. Descriptive statistics and inferential statistics were used to describe the data. The findings of the study demonstrated no significant difference ($p > .05$) in participatory communication methods used by special education teachers for demonstrating mastery of mathematical skills of algebra and geometry to pupils with moderate hearing impairment based on gender, designation and district. The results of this study showed that participatory communication methods can help increase pupils' mathematical knowledge and improve outcomes. It was recommended that special education need to be flexible and understand how their pupils learn best.

**Keywords:** Participatory Communication Methods, Special Education Teachers, Mastery, Mathematical Skills, Algebra, Geometry, Pupils, Moderate Hearing Impairment, Higher Secondary Level

## 1. Introduction

When Pakistan was founded in 1947, the government's struggles were focused on nation-building, and educational opportunities for youngsters with disabilities were limited. Non-governmental organizations (NGOs) increased, primarily in cities, providing assistance to huge numbers of disabled people. The federal government launched nationwide special education programs in all regions of the country in 1981, the International Year of Disabled Persons (American Speech-Language-Hearing Association, 2005). The Ministry of Health, Special Education, and Social Welfare established the General Directorate of Special Education in 1985 to organize and implement services for people with disabilities. The Directorate's program initially focused on special education, but overtime, they grew to include early detection, dealing, and rehabilitation (Alton-Lee, 2003).

Currently, the focus of program development is on integrating disabled people not only into education and other services, but also into the larger community (Atkinson & Shiffrin, 1968). Both administrative and legislative assistance is being provided for these programs. As a parent of a student who has recently been diagnosed with hearing loss, you will be faced with many difficult decisions regarding your child's moderate hearing impairment

and treatment options. It's problem to hear or understand sounds if you have hearing loss (also known as moderate hearing impairment). In accordance with the Persons with Disabilities Act 1995, hearing impairment means a loss of 60 decibels or more in an ear that is better at frequency communication. Moderate hearing impairment is a general term that includes both deaf and hard of hearing, meaning people with any type or degree of hearing loss who have difficulty working in the traditional way (Atkinson, 2010). For the present study, the definition of moderate hearing impairment is "a holistic term that includes all degrees of hearing loss, both deaf and impaired hearing".

Some pupils are born with hearing loss. Due to moderate hearing impairment a lot of educational, social and emotional problems are faced by the pupils. Mathematics has been extremely beneficial to all human endeavor. It is an essential part of preparing people for new challenges. A person can increase its capacity for logical reasoning, spatial imagery, analysis, and abstract thought through the study of mathematics. By studying and using mathematics, pupils gain numeracy, reasoning, thinking, and problem-solving skills (Johnson et al., 2007). Along with science and technology, these are valued in daily life and the workplace. A workforce that is highly versed in science and technology must start with a strong foundation in mathematics (Barrett, 2005).

Numerous people believed that mathematics was too difficult for them to comprehend or apply in their daily lives. Actually, mathematics is a language and a tool for dealing with problems of all sizes. Mathematical reasoning is necessary to solve common problems like budgeting, and it is the tool we use to do it. While acknowledging the value and contribution of mathematics to the modern culture of science and technology, it has been said that "without mathematics there is no science, without science there is no modern technology, and without modern technology there is no modern society." Mathematics knowledge and skill provide a key for entry into a rapidly evolving technological world (Brun, 2018).

In comprehensible advancements in technology have had a profound impact on how we live. As the world continues to evolve, no one can predict what mathematical abilities will be necessary in technology, industry, and daily life. But for those who use and create new technologies and their applications, mathematics will be crucial. Mathematical concepts and procedures are necessary to comprehend, solve, and convey problems in both simple and complicated circumstances (Miller & Rollnick, 2012). One of the first people to notice a student's academic achievement is a teacher (Nurahman et al., 2019). Teachers actively involve their pupils in the learning process in constructive mathematics courses (Darling-Hammond, 2006). Despite using a variety of techniques, constructive educators frequently use the five contextual participatory communication methods of relating, repetition time testing, pair work, manipulation tools, mathematics games, experiencing, applying, cooperating, and transferring. Pupils discover that even in mathematics, the "correct" solution might depend on how it is perceived (Werfel & Reynolds, 2019).

Pupils with moderate hearing impairment are the most significant part of the population in the special education institutions of the Punjab, Pakistan. It was needed to inquire the participatory communication methods used by special education teachers for demonstrating mastery of mathematical skills of algebra and geometry to pupils with moderate hearing impairment at Higher Secondary Level in the Punjab, Pakistan". Therefore, the findings of the study will be of significance in terms of engaging pupils to acquire the mathematical skills of algebra and geometry. It will be helpful for hearing impaired pupils in the way to gain mathematical knowledge.

### 1.1 Objectives of the Study

The objectives of the study were to:

1. Find out strategies effectively used by special education teachers for demonstrating mastery of mathematical skills of algebra and geometry to pupils with moderate hearing impairment at Higher Secondary Level.
2. Assess the difference in participatory communication methods used by special education teachers for demonstrating mastery of mathematical skills of algebra and geometry to pupils with moderate hearing impairment based on gender.
3. Determine the difference in participatory communication methods used by special education teachers for demonstrating mastery of mathematical skills of algebra and geometry to pupils with moderate hearing impairment based on designation.

4. Ascertain the difference in participatory communication methods used by special education teachers for demonstrating mastery of mathematical skills of algebra and geometry to pupils with moderate hearing impairment based on district.

### 1.2 Research Questions

The study was conducted to find answers to the following questions:

1. What are the effective strategies used by special education teachers for demonstrating mastery of mathematical skills of algebra and geometry to pupils with moderate hearing impairment at Higher Secondary Level?
2. Is there any difference in participatory communication methods used by special education teachers for demonstrating mastery of mathematical skills of algebra and geometry to pupils with moderate hearing impairment based on gender?
3. Is there any difference in participatory communication methods used by special education teachers for demonstrating mastery of mathematical skills of algebra and geometry to pupils with moderate hearing impairment based on designation?
4. Is there any difference in participatory communication methods used by special education teachers for demonstrating mastery of mathematical skills of algebra and geometry to pupils with moderate hearing impairment based on district?

## 2. Literature Review

Hearing loss is due to a loss in the sensitivity of the auditory system and/or decreased speech intelligibility (Traxler, 2010). Hearing loss is sometimes called hearing loss or hearing loss depending on the kind, degree of moderate hearing impairment and configuration (Asha & Muthiah, 2005). Three basic hearing loss categories exist i.e. mixed, conductive and sensory neural. A sensory neural hearing loss is related to auditory malfunction by cochlear (sensory) or 8$^{th}$ nerve (neural). Sensory neural hearing loss can most often not be repaired by medicine or surgery. Presbycusis is a sensory loss of hearing that progressively affects your hearing in both ears, later in life. The loss of presbycusis for high-tone noises is generally higher. In the case of conductive hearing loss, sound waves can pass easily through any of the parts of the outer or middle ear (ossicles). Because of conductive hearing loss, it is more difficult to hear noises as hearing becomes impaired (Pagliaro, 1998). A medical or surgical problem may be to blame for this type of hearing loss. Damage to the exterior and/or middle ear conductive pathways, as well as the inner ear nerve or sensory hair cells, causes mixed hearing loss (Asha & Muthiah, 2005). The degree of hearing loss can have a significant impact on pupils with hearing loss because even minor hearing loss may be educational in school settings (Resnick, 1975). Any hearing deficit that might impede with access to schooling and influence a child or youth's capacity to share, learn and establish connections between the parents was identified as an educationally important hearing loss (Johnson & Seaton, 2020). The most common sensory impairment around the world, both in industrialized and developing regions, is hearing loss, which is a public health concern. Two thirds of the world's hearing loss issues are in the developing countries with a high proportion of infants. According to Jensen, Koch, and Home (2013), hearing loss in pupils is associated with issues with language, speech, and cognition that can have an impact on learning, harm social interactions, and limit employment opportunities. Three reasons why hearing loss occurs (Drew & Mackie, 2011). There may be a risk of hearing loss depending on the type of noise, the intensity of the noise, and the length of time spent, listening to the sound. Noise-induced hearing loss is probably a contributor to acquired hearing loss (Noise induced hearing loss). The use of PLD and occupational noise exposure, including music, are the two causes of Noise-Induced hearing loss that are highly increasing. Genetic disorders may be autosomal dominant or autosomal recessive in nature. There are other, more uncommon types of hereditary hearing loss, such as X-linked hearing loss. Warrens Burg Syndrome and Neuro-Fibromatosis are genetic disorders that also impair hearing (Rheinberg, 2000). Ototoxic medications, such as chemotherapy drugs, are those that are known to be harmful to the ears (Sheridan, 2016). A head injury can result in traumatic brain injury (TBI), skull fractures, and hearing loss. Autoimmune Inner Ear Disease develops when the immune system attacks inner ear cells that are mistaken for viruses or bacteria (Shakirova, 2007). They can be brought on by isolation or other autoimmune diseases that affect the entire body, like labyrinthine disorders (Mujtaba et al., 2012). Lyme disease and Cogan syndrome are examples of systemic immunological illnesses that have been connected to AIED. Examples of infectious diseases that can be bacterial, viral, or parasitic include

meningitis, mumps, and measles. Red blood cell malformations, high blood pressure, and diabetes (vertebrobasilar) are all vascular weaknesses (Eggermont, 2017).

The word "teaching" has two main definitions: either it describes the work of a group of people known as "teachers," or it describes a series of activities intended to help someone develop new abilities, knowledge, attitudes, or interests. But understanding the idea is not simple (Rajagopalan, 2019). Teaching involves a three-way interaction between the teacher and the student as well as the learner's actions and attempts to influence their behaviors (Felder et al., 1998). Numerous professional teaching standards demonstrate that the teaching community has come to an understanding of what it takes to be an outstanding teacher in a variety of professions. These criteria include crucial pedagogical knowledge, skills, attitudes, and commitments, even though their main focus is on what teachers do to improve student outcomes (Rajagopalan, 2019; Hidayat et al., 2020). In pedagogy, the science of teaching, one's master plan should include a teaching technique, teaching materials, and instructional goals (Soeharto et al., 2019). Based on what pupils can actually learn and what they expect at a given stage of development, specific educational goals and activities are selected. The instructor controls every aspect of the learning environment, including the tools and instructional strategies (Tulbure, 2011). Teachers need to use multiple strategies like sign language, Interpreter, Visual Aids and Multi-media to help pupils understand math concepts. Math concepts must be applied with even more practice for pupils who struggle to learn them (Friedrich & Mandl, 2006).

Another technique that has improved student comprehension is the distributed curriculum approach, which involves teaching mathematical ideas and abilities over the course of the entire school year in smaller doses as opposed to all at once. Pupils with special needs are pupils with identified disability, health, or mental health conditions requiring early intervention, special education services, or other specialized services and supports; or pupils without identified conditions, but requiring specialized services, supports, or monitoring (Harth & Panke, 2019). "Pupils who are deaf typically struggle with articulation and have hearing difficulties that make it difficult for them to understand information conveyed through sounds. This makes it difficult for the pupils to understand much of the teacher's information (Stone, 1994). As a result, deaf pupils typically encounter some difficulties during the teaching and learning processes, particularly when it comes to comprehending the content opposed to hearing pupils. Due to their deafness, they therefore require instructors who can effectively convey the information (Al-Sad & Yunus, 2020). Program for hearing-impaired pupils who are deaf or hard of hearing require special consideration from team members working with them as well as attention to the requirements of the task (Tarman, 2010). As a place to start when considering potential changes, strategies are offered (Jalbani, 2014). When choosing a teaching strategy, everyone on the team should be involved in the decision-making process (Huo, 2018). A hearing loss may hinder the development of mathematical ability for a variety of reasons. Pupils who are deaf or hard of hearing can learn math concepts just like their hearing peers (Meadow, 1980). When it comes to learning math, deaf and hard-of-hearing pupils may face a number of challenges.

## 3. Research Methodology

### 3.1 Research Design

Research design is the glue that holds the research project together. It helps to provide a structure and direction to the research, yielding favourable results (Jain, 2024). The current study was descriptive in its nature. Survey design was observed to approach the respondents and collect the data for the study.

### 3.2 Research Population

The *population* is the cluster of people, events, things, or other phenomena in which researchers are most interested. It is often the “who” or “what” that one wishes to be able to say something about at the end of study (Sheppard, 2020). Teachers teaching to pupils with hearing impairment were taken as the population of study. Researcher found that there were 294 institutions, 2406 Special Education Teachers out of which 598 special education teachers were teaching to pupils with hearing impairment in Punjab Province, Pakistan. Thereby, 598 special education teachers teaching to pupils with hearing impairment in the special education institutions of the Punjab province made up the population of the study.

### 3.3 Sample and Sampling Technique

Sampling technique is a method used to choose representatives from the entire population, which may be

challenging to manage due to its size. It is a method of choosing a group of participants for a study in such a way that they accurately reflect the larger group from which they are drawn. Sixty special education teachers teaching to pupils with hearing impairment was taken as the sample of the study. Convenience sampling technique was used to choose the sample of the sixty special education teachers from pulic special education schools.

### 3.4 Research Instrument

A questionnaire is a tool for collecting information from the respondents. The research instrument (questionnaire) was consisted of two parts. First part was containing demographic attributes and second was based on statements. In the main part, investigator had asked the demographics. Second part was comprised of questionnaire containing the questions/statements that were asked from the respondents to provide the required information. For data collection, a questionnaire for pupils was constructed by the researcher under the guidance of supervisor. All the required information and views of respondents were obtained through questionnaire.

Table 1: Frequency Distribution of Gender

| Gender | Frequency (f) | Percent (%) | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| Male | 19 | 31.7 | 31.7 | 31.7 |
| Female | 41 | 68.3 | 68.3 | 100.0 |
| Total | 60 | 100.0 | 100.0 | |

Table 1 demonstrates that the total number of respondents who responded to the questionnaire was 60 in numbers. 19 males and 41 females responded to the questionnaire. The percentage of male respondents was 31.7% while the female respondents were 68.3%.

Table 2: Designation of Respondents

| Designation | Frequency (f) | Percent (%) | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| Senior Special Education Teachers | 26 | 36.7 | 36.7 | 36.7 |
| Junior Special Education Teachers | 34 | 63.4 | 63.4 | 100.0 |
| Total | 60 | 100.0 | 100.0 | |

Table 2 demonstrates the results that the total number of respondents who responded to the questionnaire was 60 in numbers. 26 senior special education teachers and 34 junior special education teachers responded over the scale. The percentage of JSET respondents was 36.7%, and SSET respondents were 63.4%.

Table 3: District of Respondents

| District | Frequency (f) | Percent (%) | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| Faisalabad | 21 | 33.9 | 33.9 | 33.9 |
| Lahore | 39 | 66.1 | 66.1 | 100.0 |
| Total | 60 | 100.0 | 100.0 | |

Table 3 illustrates the results about the district of respondents. The percentage of respondents from the Faisalabad was 33.9% and percentage of respondents from Lahore was 66.1%.

Table 4: Ages of Respondents in Year

| Ages | Frequency (f) | Percent (%) | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| 26 to 30 | 18 | 30.0 | 30.0 | 30.0 |
| 31 to 35 | 19 | 31.7 | 31.7 | 61.7 |
| 36 to 40 | 18 | 30.0 | 30.0 | 91.7 |
| 41 to 45 | 5 | 8.3 | 8.3 | 100.0 |
| Total | 60 | 100.0 | 100.0 | |

Table 4 mentions that 30.0% of the respondents were with the age from 26 to 30 years, 31.7% from 31 to 35 years, 30.0% from 36 to 40 years and 8.3% from 41 to 45 years.

Table 5: Professional's Qualification

| Qualification | Frequency (f) | Percent (%) | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| B.Ed. | 6 | 10.0 | 10.0 | 10.0 |
| M.A | 23 | 38.3 | 38.3 | 48.3 |
| M.Ed. | 17 | 28.3 | 28.3 | 76.7 |
| M.Phil. | 14 | 23.3 | 23.3 | 100.0 |
| Total | 60 | 100.0 | 100.0 | |

Table 5 describes that the total number of respondents who responded to the questionnaire was 100 in numbers. As for as the Qualification of respondents is concerned the 6 B.Ed. 23 Master's degree holders' degree holders,17 M.Ed., and14 M.Phil. Scholar responded to the questions. The percentage of B.Ed. degree holders was 10.0% M.Ed. `was 38.3%, Master's degree holders' respondents was28.3%, the percentage of M. Phil. Scholars respondents is 23.3%.

Table 6: Experience of respondents in years

| Age | Frequency (f) | Percent (%) | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| 1-5Y | 24 | 40.0 | 40.0 | 40.0 |
| 6-10Y | 23 | 38.3 | 38.3 | 78.3 |
| 11-15Y | 12 | 20.0 | 20.0 | 98.3 |
| 16-20Y | 1 | 1.7 | 1.7 | 100.0 |
| Total | 60 | 100.0 | 100.0 | |

Table 6 mentions that 40.0% of the respondents' experience from 1 to 5 years, 38.3% from 6 to 10 years 20.0% from 11to15 years and 1.7 from16 to 20 years.

### 3.5 Validity and Reliability

A specialist was shown the tool. The specialist offered insightful advice. Suggestions were taken into account. The instrument is subjected to expert validation for construct validity and content. Data were gathered using the instrument following instrument validation. It was determined the instrument's dependability following instrument validation. The Cronbach's alpha was determined using SPSS version 23. Given that the questionnaire had four sections, the Cronbach alpha was calculated for each section as well as the entire questionnaire, and the results are discussed below.

Table 7: Reliability Analysis of the Study Variable (N=60)

| Variable | K | M | SD | Range | | A |
|---|---|---|---|---|---|---|
| | | | | Actual | Potential | |
| Teaching Strategies Questionnaire | 31 | 87 | 22.3 | 58-123 | 31-123 | 0.95 |

*K=No. of items in scale and subscale; M=Mean; SD=Standard Deviation; a= Cronbach's alpha*

Table 7 shows the good reliability of assessment measures to carry the further analysis of the study. The reliability index of r=0.95 exhibited that there was very strong level of reliability exists in the questionnaire which made it ready to be used in the study for future workout.

### 3.6 Data Collection Procedure

The researcher collected data by using a structured self-developed questionnaire. The researchers visited schools, met different teachers of special education department and collected data from them. All the collected data was based on teaching experience of teachers.

## 4. Data Analysis

After the collection of data, the data were tabulated and analyzed with the help of Statistical Package for Social Sciences (SPSS). Descriptive statistics and inferential statistics such as frequency, percentage, and independent sample t-test were used to describe the data. Tables were also used to provide brief and comprehensive understanding of results.

Likert scale was used which is considered a good way for getting information and option as five-point scale provides a range of responses to be observed (Anderson, 2004) so it was used by the researcher to know the range of their responses.

Table 8: Statement 1: "Special education teachers employ "Flip Chart" for demonstrating mastery of Mathematical skills to pupils with moderate hearing impairment".

| Scale | Frequency (f) | Percent (%) | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| Absolutely yes | 22 | 36.7 | 36.7 | 36.7 |
| Yes | 20 | 33.3 | 33.3 | 70.0 |
| Not Sure | 11 | 18.3 | 18.3 | 88.3 |
| No | 4 | 6.7 | 6.7 | 95.0 |
| Absolutely No | 3 | 5.0 | 5.0 | 100.0 |
| Total | 60 | 100.0 | 100.0 | |

Table 8 indicates that 36.7% of respondents absolutely agreed with the statement, 33.3% agreed with the statement, 18.3% were not sure, 6.7% displayed disagreement, and 5.0% respondents absolutely negated the statement.

Table 9: Statement 2:"Special education teachers employ "Sign Language" for demonstrating mastery of Mathematical skills to pupils with moderate hearing impairment".

| Scale | Frequency (f) | Percent (%) | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| Absolutely yes | 31 | 51.7 | 51.7 | 51.7 |
| Yes | 21 | 35.0 | 35.0 | 86.7 |
| Not Sure | 6 | 10.0 | 10.0 | 96.7 |
| Absolutely No | 2 | 3.3 | 3.3 | 100.0 |
| Total | 60 | 100.0 | 100.0 | |

Table 9 indicates that 51.7% of respondents absolutely agreed with the statement, 35.0% agreed with the statement, 10.0% were not sure, and 3.3% respondents absolutely negated the statement.

Table 10: Statement 3:"Special education teachers employ "Interpretation" for demonstrating mastery of Mathematical skills to pupils with moderate hearing impairment"

| Scale | Frequency (f) | Percent (%) | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| Absolutely Yes | 30 | 51.7 | 51.7 | 51.7 |
| Yes | 24 | 35.0 | 35.0 | 86.7 |
| Not Sure | 6 | 10.0 | 10.0 | 100.0 |
| Total | 60 | 100.0 | 100.0 | |

Table 10 indicates that 51.7% of respondents absolutely agreed with the statement, 35.0% agreed with the statement whereby 10.0% were not sure about the statement.

Tables 11: Statement 4: "Special education teachers employ "Multi-Media" for demonstrating mastery of Mathematical skills to pupils with moderate hearing impairment."

| Scale | Frequency (f) | Percent (%) | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| Absolutely Yes | 20 | 33.3 | 33.3 | 33.3 |
| Yes | 21 | 35.0 | 35.0 | 70.0 |
| Not Sure | 15 | 25.0 | 25.0 | 93.3 |
| No | 3 | 5.0 | 5.0 | 98.3 |
| Absolutely No | 1 | 1.7 | 1.7 | 100.0 |
| Total | 60 | 100.0 | 100.0 | |

Table 11 indicates that 33.3% of respondents absolutely agreed with the statement, 35.0% agreed with the statement, 25.0% were not sure, 5.0% showed disagreement with the statement, and 1.7% absolutely negated the statement.

Table 12: Statement 5: "Special education teachers employ "Visual Aids" for demonstrating mastery of Mathematical skills to pupils with moderate hearing impairment".

| Scale | Frequency (f) | Percent (%) | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| Absolutely Yes | 24 | 40.0 | 240.0 | 40.0 |
| Yes | 31 | 51.7 | 251.7 | 91.7 |
| Not Sure | 4 | 6.7 | 6.7 | 98.3 |
| Absolutely No | 1 | 1.7 | 1.7 | 100.0 |
| Total | 60 | 100.0 | 100.0 | |

Table 12 indicates that 40.0% of respondents absolutely agreed with the statement, 51.7% agreed with the statement, 6.7% were not sure about the statement, whereby 1.7% absolutely negated the idea.

Table 13: Statement6: "Special education teachers employ "Mathematical Games" for demonstrating mastery of Mathematical skills to pupils with moderate hearing impairment."

| Scale | Frequency (f) | Percent (%) | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| Absolutely Yes | 13 | 21.7 | 21.7 | 21.7 |
| Yes | 32 | 53.3 | 53.3 | 75.0 |
| Not Sure | 11 | 18.3 | 18.3 | 93.3 |
| No | 3 | 5.0 | 5.0 | 98.3 |
| Absolutely No | 1 | 1.7 | 1.7 | 100.0 |
| Total | 60 | 100.0 | 100.0 | |

Table 13 indicates that 21.7% of respondents were absolutely agreed with the statement, 53.3% agreed with the statement, 18.3% were not sure, 5.0% disagreed, whereby 1.7% absolutely negated the statement.

Table 14: Statement7: "Special education teachers employ "Group Work" for demonstrating mastery of Mathematical skills to pupils with moderate hearing impairment."

| Scale | Frequency (f) | Percent (%) | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| Absolutely Yes | 14 | 23.3 | 23.3 | 23.3 |
| Yes | 18 | 30.0 | 30.0 | 53..3 |
| Not Sure | 21 | 35.0 | 35.0 | 88.3 |
| No | 4 | 6.7 | 6.7 | 95.0 |
| Absolutely No | 3 | 5.0 | 5.0 | 100.0 |
| Total | 60 | 100.0 | 100.0 | |

Table 14 indicates that 23.3% of respondents responded as absolutely yes with the statement, 30.0% agreed with the statement, 35.0% were not sure with the idea, 6.7% disagreed, while 5.0% absolutely negated the statement.

Table 15: Statement 8:"Special education teachers employ "Pair Work" for demonstrating mastery of Mathematical skills to pupils with moderate hearing impairment."

| Scale | Frequency (f) | Percent (%) | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| Absolutely Yes | 20 | 33.3 | 33.3 | 33.3 |
| Yes | 24 | 40.0 | 40.0 | 73.3 |
| Not Sure | 8 | 13.3 | 13.3 | 86.7 |
| No | 7 | 11.7 | 11.7 | 98.3 |
| Absolutely No | 1 | 1.7 | 1.7 | 100.0 |
| Total | 60 | 100.0 | 100.0 | |

Table 15 indicates that 33.3% of respondents responded as absolutely yes with the statement, 40.0% showed agreement with the statement, 13.3% were unsure with the statement, 11.7% disagreed, whereby 1.7% absolutely negated the statement. It was evident that almost two third of the respondents opined that special education teachers were using the "Pair Work" for demonstrating master of Mathematical skills to the pupils with moderate hearing impairment.

Table 16: Statement 9:"Special education teachers employ "Manipulation Tools" for demonstrating mastery of Mathematical skills to pupils with moderate hearing impairment.

| Scale | Frequency (f) | Percent (%) | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| Absolutely Yes | 16 | 26.7 | 26.7 | 26.7 |
| Yes | 18 | 30.0 | 30.0 | 56.7 |
| Not Sure | 22 | 36.7 | 36.7 | 93.3 |
| No | 3 | 5.0 | 5.0 | 98.3 |
| Absolutely No | 1 | 1.7 | 1.7 | 100.0 |
| Total | 60 | 100.0 | 100.0 | |

Table 16 indicates that 26.7% of respondents responded as absolutely yes with the statement, 30.0% agreed, 36.7% were not sure with the statement, 5.0% disagreed with the statement, while 1.7% absolutely negated the statement.

Table 17: Statement 10: "Special education teachers employ "Repetition" for demonstrating mastery of Mathematical skills to pupils with moderate hearing impairment."

| Scale | Frequency (f) | Percent (%) | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| Absolutely Yes | 16 | 26.7 | 26.7 | 26.7 |
| Yes | 26 | 43.3 | 43.3 | 70.0 |
| Not Sure | 8 | 13.3 | 13.3 | 83.3 |
| No | 2 | 3.3 | 3.3 | 86.7 |
| Absolutely No | 8 | 13.3 | 13.3 | 100.0 |
| Total | 60 | 100.0 | 100.0 | |

Table 17 indicates that 26.7% of respondents responded as absolutely yes with the statement, 43.3% agreed with the statement, 13.3% were not sure, 3.3% disagreed, whereby 13.3% absolutely negated the statement.

Table 18: Statement 11:"Special education teachers employ "Flash Cards" for demonstrating mastery of Mathematical skills to pupils with moderate hearing impairment.

| Scale | Frequency (f) | Percent (%) | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| Absolutely Yes | 25 | 41.7 | 41.7 | 41.7 |
| Yes | 22 | 36.7 | 36.7 | 78.3 |
| Not Sure | 12 | 20.0 | 20.0 | 98.3 |
| Absolutely No | 1 | 1.7 | 1.7 | 100.0 |
| Total | 60 | 100.0 | 100.0 | |

Table 18 indicates that 41.7% of respondents responded as absolutely yes with the statement, 36.7% showed positive inclination with the statement, 20.0% were not sure about the statement, whereby 1.7% absolutely negated the statement that "Flash Cards" are utilized the special education teachers to teach the mastery of Mathematical skills to the pupils with moderate hearing impairment.

Table 19: Statement 12: "Special education teachers employ "Draw Picture" for demonstrating mastery of Mathematical skills to pupils with moderate hearing impairment."

| Scale | Frequency (f) | Percent (%) | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| Absolutely Yes | 16 | 26.7 | 26.7 | 26.7 |
| Yes | 29 | 48.3 | 48.3 | 75.0 |
| Not Sure | 9 | 15.0 | 15.0 | 90.0 |
| No | 5 | 8.3 | 8.3 | 98.3 |
| Absolutely No | 1 | 1.7 | 1.7 | 100.0 |
| Total | 60 | 100.0 | 100.0 | |

Table 19 indicates that 26.7% of respondents responded as absolutely yes with the statement, 48.3% showed agreement with the statement, 15.0% were not sure about the idea, 8.3% disagreed with the statement, while 1.7% absolutely negated the statement that they draw pictures for demonstrating mastery of Mathematical skills to pupils with moderate hearing impairment.

Table 20: Statement 13: "Special education teachers employ "Written Document" for demonstrating mastery of Mathematical skills to pupils with moderate hearing impairment."

| Scale | Frequency (f) | Percent (%) | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| Absolutely Yes | 21 | 35.0 | 35.0 | 35.0 |
| Yes | 26 | 43.3 | 43.3 | 78.3 |
| Not Sure | 9 | 15.0 | 15.0 | 93.3 |
| No | 3 | 5.0 | 5.0 | 98.3 |
| Absolutely No | 1 | 1.7 | 1.7 | 100.0 |
| Total | 60 | 100.0 | 100.0 | |

Table 20 indicates that 35.0% of respondents responded as absolutely yes with the statement, 43.3% showed positive inclination with the statement, 15.0% were not sure with the statement, 5.0% disagreed with the idea, while 1.7% absolutely negated the statement that they use written documents for demonstrating master of Mathematical skills to pupils with moderate hearing impairment.

Table 21: Statement 14:"Special education teachers employ "Time Testing" for demonstrating mastery of Mathematical skills to pupils with moderate hearing impairment."

| Scale | Frequency (f) | Percent (%) | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| Absolutely Yes | 15 | 25.0 | 25.0 | 25.0 |
| Yes | 28 | 46.7 | 46.7 | 71.7 |
| Not Sure | 12 | 20.0 | 20.0 | 91.7 |
| No | 3 | 5.0 | 5.0 | 96.7 |
| Absolutely No | 2 | 30.0 | 30.0 | 100.0 |
| Total | 60 | 100.0 | 100.0 | |

Table 21 indicates that 25.0% of respondents responded as absolutely yes with the statement, 46.7 agreed with the statement, 20.0% were not sure about the idea, 5.0% showed disagreement with the statement, while 1.7% absolutely negated the statement.

Table 22: Statement 15:"Special education teachers give "Extra Time" for demonstrating mastery of Mathematical skills to pupils with moderate hearing impairment."

| Scale | Frequency (f) | Percent (%) | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| Absolutely Yes | 33 | 55.0 | 55.0 | 55.0 |
| Yes | 19 | 31.7 | 31.7 | 86.7 |
| Not Sure | 4 | 6.7 | 6.7 | 93.3 |
| No | 3 | 5.0 | 5.0 | 98.3 |
| Absolutely No | 1 | 1.7 | 1.7 | 100.0 |
| Total | 60 | 100.0 | 100.0 | |

Table 22 indicates that 55.0% of respondents responded as absolutely yes with the statement, 31.7% showed positive inclination with the statement, 6.7% were not sure with the statement, 5.0% disagreed, whereby 1.7% absolutely negated the idea.

Table 23: Summary of participatory communication methods to demonstrate mastery of mathematical skills of algebra and geometry for pupils with hearing impairment at higher secondary level in Punjab

| **Sr. No** | **Supportive teaching strategies used by special education Teachers for Teaching mathematical skills of algebra and geometry to pupils with moderate hearing impairment** | **Percentage** |
|---|---|---|
| 1 | Special education Teachers employ "Flip Chart" for demonstrating mastery of mathematical skills of algebra and geometry to pupils with moderate hearing impairment. | 76.2% |
| 2 | Special education Teachers employ "Sign Language" for demonstrating mastery of mathematical skills of algebra and geometry to pupils with moderate hearing impairment. | 67.3% |

| | | |
|---|---|---|
| 3 | Special education Teachers employ "Interpretation" for demonstrating mastery of mathematical skills of algebra/geometry to pupils with moderate hearing loss. | 51.4% |
| 4 | Special education Teachers employ "Multi-Media" for demonstrating mastery of mathematical skills of algebra and geometry to pupils with moderate hearing impairment. | 68.1% |
| 5 | Special education Teachers employ "Visual Aids" for demonstrating mastery of mathematical skills of algebra and geometry to pupils with moderate hearing impairment. | 88.5% |
| 6 | Special education Teachers employ "Mathematical Games" for demonstrating mastery of mathematical skills of algebra and geometry to pupils with moderate hearing impairment. | 93.2% |
| 7 | Special education Teachers employ "Group Work" for demonstrating mastery of mathematical skills of algebra and geometry to pupils with moderate hearing impairment. | 58.7% |
| 8 | Special education Teachers employ "Pair Work" for demonstrating mastery of mathematical skills of algebra and geometry to pupils with moderate hearing impairment. | 69.9% |
| 9 | Special education Teachers employ "Manipulation Tools" for demonstrating mastery of mathematical skills of algebra and geometry to pupils with moderate hearing impairment. | 84.8% |
| 10 | Special education Teachers employ "Repetition" for demonstrating mastery of mathematical skills of algebra/geometry to pupils with moderate hearing loss. | 88.7% |
| 11 | Special education Teachers employ "Flash Cards" for demonstrating mastery of mathematical skills of algebra and geometry to pupils with moderate hearing impairment. | 81.0% |
| 12 | Special education Teachers employ "Draw Picture" for demonstrating mastery of mathematical skills of algebra and geometry to pupils with moderate hearing impairment. | 61.3% |
| 13 | Special education Teachers employ "Written Document" for demonstrating mastery of mathematical skills of algebra and geometry to pupils with moderate hearing impairment. | 53.5% |
| 14 | Special education Teachers employ "Time Testing" for demonstrating mastery of mathematical skills of algebra and geometry to pupils with moderate hearing impairment. | 64.6% |
| 15 | Special education teachers give "Extra Time" for demonstrating mastery of mathematical skills of algebra and geometry to pupils with moderate hearing impairment. | 94.7% |

Table 23 demonstrates that "extra time" and "Mathematical Games" were the most effective methods used by special education teachers to teach mathematical skills to pupils with moderate hearing impairment, whereby "interpretation" and "Written Document" were rarely used by the teachers to teach math skills to the pupils with hearing impairment.

Table 24: Independent samples t-test comparing the participatory communication methods to demonstrate mastery of mathematical skills of algebra and geometry for pupils with hearing impairment at higher secondary level in Punjab based on gender.

| **Gender** | **N** | **Mean** | **SD** | **df** | **t** | **p** |
|---|---|---|---|---|---|---|
| Male | 19 | 3.88 | 0.570 | 58 | 1.498 | 0.138 |
| Female | 41 | 4.0 | 0.981 | | | |

Table 24 revealed that there was no significant difference ($p>0.05$) in participatory communication methods to demonstrate mastery of mathematical skills of algebra and geometry for pupils with hearing impairment at higher secondary level in Punjab based on the gender of the teachers.

Table 25: Independent samples t-test comparing the participatory communication methods to demonstrate mastery of mathematical skills of algebra and geometry for pupils with hearing impairment at higher secondary level in Punjab based on locality of Faisalabad city.

| Designation | N | Mean | SD | df | t | p |
|---|---|---|---|---|---|---|
| Senior Special Education Teachers | 26 | 3.71 | 0.672 | 58 | 0.595 | 0.141 |
| Junior Special Education Teachers | 34 | 3.84 | 0.781 | | | |

Table 25 revealed that there was no significant difference ($p>0.05$) in participatory communication methods to demonstrate mastery of mathematical skills of algebra and geometry for pupils with hearing impairment at higher secondary level in Punjab based on the designation of the teachers.

Table 26: Independent samples t-test comparing the participatory communication methods to demonstrate mastery of mathematical skills of algebra and geometry for pupils with hearing impairment at higher secondary level in Punjab based on locality of Faisalabad city.

| District | N | Mean | SD | df | t | p |
|---|---|---|---|---|---|---|
| Faisalabad | 21 | 3.78 | 0.779 | 58 | 0.893 | 0.157 |
| Lahore | 39 | 3.91 | 0.780 | | | |

Table 26 revealed that there was no significant difference ($p>0.05$) in participatory communication methods to demonstrate mastery of mathematical skills of algebra and geometry for pupils with hearing impairment at higher secondary level in Punjab based on locality of the respondents.

### 4.1 Discussion

The study was conducted to investigate the “Participatory communication methods employed by Special Education Teachers for demonstrating mastery of mathematical skills of algebra and geometry to pupils with moderate hearing impairment at Higher Secondary Level” in the Punjab, Pakistan. A structured self-designed questionnaire was administered, and the results were evaluated. Math concepts and teaching methods may be difficult for pupils to comprehend if they do not speak the basic language of the subject. A child is exposed to and learns to speak from the moment of birth. Using this as a foundation, pupils may start to comprehend and use mathematical language. Pupils who are deaf or hard of hearing struggle more to learn language and take in information from their environment. Fundamental mathematical concepts like "in front of/behind" or "heavy/ light" may not be understood by a deaf child unless they are taught in an environment that is suitable for education (Smith, 1999). It might be challenging to convince someone else of your point of view. Problem solving, the development of logic and reasoning, and communication in mathematics will all be hampered if the child and those around them are unable to do so effectively. Pupils who are deaf find it extremely challenging to solve problems because they are unable to verbalize their thoughts or make predictions about the future. A child must possess communication skills in order to engage in group activities and learn new material in the classroom. Pupils's cognitive development requires exposure to mathematical concepts and a broad language foundation, though this isn't always the case (Ray, 2001). In either the home or the classroom, this isn't always the case.

Both active and passive participation can result in learning, but pupils learn a lot more when they actively participate in projects and activities rather than passively absorbing information from the teacher. Visual representation to mathematical concepts in the classroom are especially helpful for deaf and hard-of-hearing pupils. Therefore, manipulative, games, and hobbies are necessary (Andrews et al., 2004). Pupils who are deaf or hard of hearing may benefit from using origami (paper folding technique to make artificial objects) in both general education and special education classes because many of these pupils will gain from hands-on activities. It was discovered that using origami to help hearing-impaired pupils learn and develop their arithmetic skills has been very effective (Marschark, 2003; Chen, 2006).

Based on the opinions of 60 teachers in the current study, it was determined that current methods in Pakistan are adequate. Almost 76.2% teachers used “Flip Chart” for teaching mathematical skills that are directly related to academic achievement among the pupils with hearing loss. Almost 67.3% teachers used “Sign language” for demonstrating mastery of mathematical skills of algebra and geometry to pupils with moderate hearing impairment. Almost 93.2% teachers used “mathematical games” that were directly related to academic achievement of pupils

with moderate hearing impairment. Almost 94.7% teachers effectively used a technique of "Giving Extra Time" to teach mathematical skills to pupils with moderate hearing impairment. Moreover, teachers working with pupils who have moderate hearing impairments often have subject expertise to effectively manage the pupils. Mishra and Koehler (2009) asserted that all educators need to be knowledged about the key ideas, skills, and in formation pertaining to a specific subject at the Higher Secondary Level. Because of this, teachers of hearing-impaired pupils must be conversant with various teaching methodologies as a fundamental subject in the foundation and secondary stage (Mujtaba et al., 2012).

## 5. Conclusion

The learning process of pupils improves as a result of the excellent teaching abilities of mathematics. It was generally determined that special education teachers have a high conceptual understanding of mathematical skills, their knowledge in terms of using efficient teaching strategy was a little bit limited. Furthermore, it was specifically determined that respondents' views on the use of participatory communication methods during demonstrating mastery of mathematical skills of algebra and geometry to pupils with moderate hearing impairments do not vary considerably. The results of this study also showed that participatory communication methods can help to increase pupils' mathematical knowledge and improve outcomes. The best methods used by the teachers to teach mathematical skills were the use of mathematical games and giving extra time to compelte the math assignments to the pupil with hearing impairment.

### 5.1 Recommendations

Following recommendations were made on the results and conclusions:

1. Special education teaching need to be flexible and teachers must understand how their pupils learn best to boost their mathematical skills.
2. Special education teachers should have had additional training on the topic to help their pupils learn mathematical skills of algebra and geometry.
3. Professional training courses should be organized by the concened authorities to enhance the knowledge of the special education teachers.

### 5.2 Limitations

Limitations of the study were the following:

1. As this study instrument was by researcher themselves, the result must becarefully be interpreted.
2. As the simple random sampling technique was not possible, the convenience sampling technique was used.

### 5.3 Delimitations

Delimitations of the study were the following:

1. As a result of limited time and resources the following parameters were established based on the research.
2. Because there were no standard tools, the researcher devised his own research instrument. As a result the findings can be generalized.

### 5.4 Future Research

1. Future research should be conducted on the targeted demographics of the study to examine the teachers' perspectives of teaching methods for mathematical ideas as well as the difficulties they encounter while attempting to teach those concepts.
2. Future study with a large sample size is advised to obtain more precise results.

## References

Al-Sad, H. W., & Yunus, K. (2020). Genders patterns on Facebook: A Jordanian sociolinguistic perspective. *International Journal of Humanities, Philosophy and Language*, *3*, 01-12.

Alton-Lee, A. (2003). Quality teaching for diverse pupils in schooling: Bestevidence synthesis June 2003. *Wellington, New Zealand: Ministry of Education.*

American Speech-Language-Hearing Association. (2005). (Central) auditory processing disorders.

Andrews, J. F., Leigh, I. W.,& Weiner, M. T. (2004). *Deaf people: Evolving perspectives from psychology, education, and sociology*. Boston: Allyn & Bacon.

Asha, P. S., & Muthiah, P. (2005). Effects of temperature, salinity and pH on larval growth, survival and development of the sea cucumber Holothuria spinifera Theel. *Aquaculture*, *250*(3-4), 823-829.

Atkinson, D. (2010). Theorizing how student teachers form their identities in initial teacher education. *British Educational Research Journal*, *30*(3), 379-394.

Atkinson, R.C. & Shiffrin, R.M. (1968): "Chapter: Human Memory: A Proposed System and its Control Processes". In: Spence, K.W. & Spence, J.T.(eds.): The Psychology of Learning and Motivation (Vol. 2). New York: Academic Press.89-195.

Barrett, E. (2005). Mathematics: it's all about language.

Brun, D. (2018, June 19). *7 Tips for Teaching Maths to Deaf Learners*.

Chen, K. (2006). Mathinmotion: Origamimath for pupils who are deaf and hard of hearing. *Journal of deaf studies and deaf education*, *11*(2), 262-266.

Darling-Hammond, L. (2006). Constructing 21st century teacher education. Journal of Teacher Education, 57, (3), 300-314

Drew, V., Mackie, L. (2011). Extending the constructs of active learning: Implications` for teachers' pedagogy and practice. Curriculum Journal, 22(4), 451-467.

Eggermont, J. J. (2017). Acquired hearing loss and brain plasticity. *Hearing Research,343*, 176-190.

Felder, R. M., Brent, R., Miller, T. K., Brawner, C. E., & Allen, R.H. (1998, November). Faculty teaching practices and perceptions of institutional attitudes toward teaching at eight engineering schools.

Friedrich, H.F. and Mandl, H. (eds.) (2006): Handbuch Lernstrategien. Handbook of Learning Strategies. Göttingen: Hogrefe. Huber, G.L. (2006): Lernen in Gruppen / Kooperatives Lernen. Learning in Groups/Cooperative Learning.

Harth, T., & Panke, S. (2019). Design Thinking in Teacher Education: Preparing Engineering Pupils for Teaching at Vocational Schools. International Journalon E-Learning, 18(4), 413-439.

Hidayat, D. S., Rahmat, C., Fattah, N., Rochyadi, E., Nandiyanto, A., & Maryanti, R. (2020). Understanding Archimedes law: What the best participatory communication methods for vocational high school pupils with moderate hearing impairment. *Journal of Technical Education and Training*, *12*(1).

Huo, W., Zhang, W., & Chen, P. S. L. (2018). Recent development of Chinese port cooperation strategies. *Research in transportation business & management*, *26*, 67-75.

Jain, Y. (2024). *5 Types of Research Design – Elements, Needs and Characteristics.* Retrieved from https://emeritus.org/in/learn/types-of-research-design/

Jalbani, L. N. (2014). The impact of effective participatory communication methods on the pupils' academic performance and learning outcome. *Munich: GRIN Verlag. Accessed November*, *23*, 2018.

Jensen, R. G., Koch, A., &Homøe, P. (2013). The risk of hearing loss in a population with a high prevalence of chronic suppurative otitis media. *International Journalof Pediatric Otorhinolaryngology*, *77*(9),1530-1535.

Johnson, C. D., & Seaton, J. B. (2020). *Educational audiology handbook*. Plural Publishing.

Johnson, G., Langley, A., Melin, L., & Whittington, R. (2007). *Strategy as practice: research directions and resources*. Cambridge University Press.

Marschark, M. (2003). Cognitive functioning in deaf adults and pupils. In M. Marschark & P. E. Spencer (Eds.), Oxford handbook of deaf studies, language, and education (pp.464–477). New York: Oxford University Press.

Meadow, K. (1980). Deafness and child development. Berkeley: University of California Press.

Miller, W. R., & Rollnick, S. (2012). *Motivational interviewing: Helping people change*. Guilford press.

Mujtaba, G., Bukhari, I., Fatima, A., & Naz, S. (2012). Causes progressive hearing loss. *Gene*, *504*(1), 98-101.

Nurahman, A., Widodo, W., Ishafit, I., & Saulon, B. O. (2019). The Development of Worksheet Based on Guided Discovery Learning Method Helped by PhET Simulations Interactive Mediain Newton's Laws of Motion to Improve Learning Outcomes and Interest of Vocational Education 10th Grade Pupils. *Indonesian Review of Physics*, *1*(2), 37-41.

Pagliaro, C. (Jan/Feb, 1998). There's no place like home – for math. *Perspectives in Education and Deafness*, *16*(3).

Rajagopalan, I. (2019). Concept of Teaching. *Shanlax International Journal of Education, 7*(2), 5-8.

Ray, E. (Nov, 2001). Discovering mathematics: The challenges that deaf/hearing-impaired pupils encounter. ACE Papers, Issue 11.

Resnick, L. B. (1975). Task analysis in instructional design: Some cases from mathematics.

Rheinberg, F. (2000): *Motivation. Stuttgart, Berlin,* Köln: Kohlhammer.

Shakirova, D. M. (2007). Technology for the shaping of college pupils' and upper-grade pupils' critical thinking. *Russian Education & Society,49*(9),42–52.

Sheppard, V. (2020). *Research Methods for the Social Sciences: An Introduction.* JIBC.

Sheridan, L. (2016). Examining change sinpre-service teachers' beliefs of pedagogy. *Australian Journal ofTeacher Education, 41*(3), 1.

Smith, M. (1999). Bibliography for teaching mathematics to deaf and hearing-impaired pupils.

Soeharto, S., Csapó, B., Sarimanah, E., Dewi, F. I., &Sabri, T. (2019). A Review of Pupils' Common Misconceptions in Science and Their Diagnostic Assessment Tools. *Jurnal Pen didikan IPA Indonesia, 8*(2), 247-266.

Stone, S. J. (1994). Participatory communication methods: Strategies for teaching pupils in multi age classrooms. *Childhood Education, 71*(2), 102-105.

Tarman, B. (2010). Global perspectives and challenges on teacher education in Turkey. *International Journal of Arts & Sciences (IJAS), 3*(17), 78-96.

Traxler, C. B. (2000). The Stanford Achievement Test, 9th edition: National norming and performance standards for deaf and hard-of-hearing pupils. *Journal of Deaf Studies and Deaf Education, 5*, 337–348

Tulbure, C. (2011). Do different learning styles require differentiated participatory communication methods? *Procedia-Social and Behavioral Sciences,11*, 155-159.

Werfel, K. L., & Reynolds, G. (2019). Teaching Phonological Awareness to Pupils with Hearing Loss Who Use Spoken Language: Six Big Ideas. *Perspectives of the ASHA Special Interest Groups, 4*(5), 954-961.