



**EXAMINING HOW EFFECTIVE TEACHING METHODS  
AND TECHNIQUES, AND MATERIALS ARE USED  
IN MATH TEACHING FOR HEARING IMPAIRED STUDENTS:  
FROM TURKISH TEACHERS' PERSPECTIVES**

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**Abstract:**

This study examines the impact of materials, teaching methods, and techniques used by teachers when educating the hearing impaired in mathematics. "Interview method," a qualitative research methodology, was employed to gather the data. The study group consisted of twenty-seven teachers selected from Schools for the Hearing Impaired in Konya LEA. For this study, the researchers developed a "Semi-Structured Interview Form" that was composed of two main items with sixteen prompts. Data were collected and then analysed with a "Descriptive Analysis Technique." The findings indicate that the methods and techniques in math teaching used by the teachers were limited. When teaching mathematics, the teachers reported that the instructional methods that they like to use the most were drama, matching, modeling and demonstration (show and do). We conclude that while teachers felt that visual and auditory materials nicely complemented effective teaching methods and techniques, these visual materials were hard to obtain. Therefore, there is a need using materials for teaching the hearing impaired, and these materials have the potential to improve learning outcomes and teaching efficacy for these students.

**Keywords:** hearing impaired students, math teaching, teachers of the hearing impaired, effective teaching methods and techniques, qualitative design

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## 1. Introduction

The term hearing impaired is often used when referring to people who are hard of hearing or have no hearing; moreover, the term deaf is often used when referring to people who cannot hear or have significant hearing loss. According to the Turkish Ministry of National Education Statistics (2016, 2017), there are approximately 740 hearing-impaired students in 42 Special Education Primary Schools for the hearing impaired. 4265 of these hearing-impaired students stay in dormitories and 1974 students live with their families. Furthermore, there are 768 students in inclusive education, 414 students in private schools, and 931 students (8 of whom are in multi-program high schools) in special vocational high schools for the deaf in Turkey (Sarı, 2017).

Stinson & Kluwin (2003) state that students with significant hearing loss lag behind hearing peers in a variety of academic domains and across settings. In addition to facing difficulties in their academic lives, hearing impaired students also experience difficulties in their social lives due to challenges with communication. Challenges in communication can impact multiple aspects of one's life including cognitive and motor skills, emotional development, literacy, writing, listening, and speaking skills which are important both for daily life and their education. In the classroom environment, the demand for elaborate communication and linguistic proficiency are often difficult for deaf students and this struggle can undermine the student's motivation to learn (Sarı, 2010).

There are currently four main approaches to teaching children who are hearing impaired: 1) visual methods such as Sign Language (Lim & Simser, 2005); 2) Total Communication, which combines approaches that emphasize lip-reading, speech, natural gestures and a manually coded Sign System which has no written form (Akçamete, 2005); 3) Auditory based methods such as Auditory-Oral approaches where children are educated within a school with other deaf children with an emphasis on auditory teaching and group instruction sessions (Akçamete, 2005); and 4) the Auditory-Verbal approaches which utilise listening as a primary modality for the development of spoken language (Girgin & Karasu, 2007). The dominant educational approach for the education of deaf children is based on speaking and listening which is an auditory-oral approach. This is achieved by exploiting the child's hearing, through the use of effective and appropriate hearing aids (or a cochlear implant), and providing an environment where the child can develop listening skills and learn a spoken language (Gregory, 2005). However, researches indicate that sign language may confer advantages when teaching math because it is a visual-spatial language which can convey more information about mathematical concepts such as size and shape (Gregory, 2005; Sarı, 2017).

Mathematics - an instrument that contains logic, intuition, resolution and individuality within itself - is most frequently used for gathering new information and finding a way to explain it (Yıkılmaz, 2012). Mathematics is critical for solving problems

in daily life or at work and can be foundational to the development of reasoning and independent thinking. Students often see maths as a quantitative skill that is only used in the classroom, but when the applicability of maths to daily life is pointed out to students, students may realize that they can use mathematical concepts to make sense of the world around them (Pagliaro & Kritzer, 2012).

Even though students with hearing impairments fall behind their peers academically, they have the ability to learn as their peers do (Meadow-Orlans, 1980; Tanrıdiler, Uzunur & Girgin, 2015). Students are more likely to be academically engaged when they can communicate with teachers and classroom peers, possibly because they have a better sense of control over their learning outcomes; they are also likely to believe that they have a good chance of succeeding academically (Antia, Sabers & Stinson, 2006). Maths is a particularly difficult subject for hearing impaired students because it contains many abstract concepts; failure to make an association between abstract and concrete information in maths may result in learning difficulties (Van Luit & Schopman, 2000). Kelly, Lang & Pagliora (2003) report that causes of difficulties in maths experienced by hearing impaired students are: (a) deficiency of preschool learning experiences, (b) linguistic deficiencies and language-oriented lessons, (c) the nature of mathematical language, (d) difficulties in reading comprehension, and (e) deficiencies in solving verbal math problems.

Mathematics is a language that uses specific symbols and concepts (Yıkılmış, 2012). The unique structure of mathematics requires one to make associations between concepts, critically think about mathematical problems, read and understand problems and express solution methods and make associations between daily life and mathematical terms. For students with hearing impairment, a delay in learning language (or not acquiring language at all) limits the ability of these students to learn the relationships between mathematical concepts and the other concepts (Tanrıdiler, 2012). If the student does not have a sufficient level of word input, then he/she cannot communicate effectively with other people and that interferes with the development of mathematical processes such as difficulties in problem solving and difficulties in making causal and logical relationships. Furthermore, hearing impaired students who have poor communication skills cannot participate in group activities and miss the opportunity to benefit from learning environments which provide essential inputs (Ray, 2001). Generally, failure to reduce the difference between the hearing impaired and hearing students' academic achievement indicates that teachers have not yet fully elucidated differences in how hearing impaired students learn. This knowledge is needed so that teachers can adjust their instructional methods to match the needs of students with impaired hearing (Marschark, Convertino & LaRock, 2006).

When hearing impaired students are deficient in vocabulary, it can impact their ability to understand mathematical relationships and, consequently, inhibit these students from learning mathematics. The ability to understand daily spoken language provides the basis for understanding - and using - mathematical language. Nevertheless, it is difficult for students who have a hearing impairment to learn

concepts which require them to make an association between daily life and mathematics. Abuzinadah, Malibari & Krause (2017) state that students with hearing impairments have difficulties in understanding concepts such as in front of, behind, under, same and different. Therefore, acquiring even a basic knowledge of mathematical information is difficult for these students.

To succeed in math, students with hearing impairments need to associate verbal and symbolic phrases correctly and they also need to be able to read and understand questions. Problem-solving skills are based on the development of oral language and it requires understanding and predicting words (Hyde, Zevenbergen & Power, 2003). According to Kelly et al. (2003), failure by students with hearing impairments in problem-solving is related to linguistic, cognitive and empirical factors. However, when verbal phrases are used less in mathematical problem-solving activities, the cognitive development of hearing impaired students is impacted negatively and, in some cases, this can cause the student to experience anxiety.

Teachers should plan their instruction to accommodate for student differences in learning style, learning speed, prior knowledge, interests and prior experience. The methods and techniques chosen by the teacher should be based on the subject he/she is teaching and math has its own unique set of teaching methods. In addition, the teacher should also consider the nature of the subject as well as the interests and abilities of the students when selecting methods and techniques for instruction. For example, drama and demonstration methods may be more effective for teaching maths to students with hearing impairments than the other methods such as question and answer method. It has been reported that it is beneficial for teachers to choose methods in which students engage in active learning experiences (Sarı, 2010). The teaching materials that the teacher utilizes while instructing subjects in math can affect the academic success of the students, especially if the materials nicely match the teaching methods and techniques. Teaching success depends on the adaption and implementation of effective pedagogical methods; it is, therefore, essential for the teacher to investigate different teaching methods such as problem-solving, inquiry-based teaching, discovery, games, lecturing, and case studies, among others. These methods contribute to effective teaching practices and student learning processes (Ünal, 2017). Research indicates that the most effective mathematics teaching and learning occur when aided by activities that require active student participation. For example, using drama method, the teachers can organize a group activity indicating a role for each student who represent a number such as 7 to be able to have effective teaching numbers and also giving role to all the students who participate class activities together.

Heddens (1986) summarizes the pedagogical influences of using materials in teaching mathematics as helping students learn: to relate real-world situations to mathematics symbolism, to work together cooperatively on solving problems, to discuss mathematical ideas and concepts, to verbalize mathematics thinking, and to make presentations in front of a large group. In order for hearing impaired students to effectively make a presentation in math, many materials can be used such as tangrams,

Cuisenaire rods, Numicon patterns, Dienes' blocks, interlocking cubes, base ten blocks, pattern blocks, colored chips, links, fraction strips, blocks, or stacks, color tiles, and geoboards (Van de Walle & Lovin, 2005). In addition to these, number lines, beans, bean sticks, and counting objects can be used by students in their math presentations.

According to Stewart & Kluwin (2001), teachers should consider the incoming knowledge of hearing impaired students in maths because taking this into account increases student success. It is for this reason that teachers should be required to include an extensive number of practices and activities using different materials to assess the prior knowledge of their students. It should be noted that assessment materials are not self-supporting and they should be used to supplement the designed lesson plans. One benefit of assessing student prior knowledge is that it presents an opportunity for all of the students in the class to share their past experiences. Once past experiences are known, it makes it easier to build on those experiences and plan new learning experiences. There is some evidence that when teachers use graphics and visual cues in math teaching, the success of students increases (Karal & Çiftçi, 2008; Nunes & Moreno, 2002). However, the nature of maths makes it particularly challenging for students with linguistic deficiencies and deficiencies in reading comprehension. Among these students are students with hearing impairment. The quality of math teaching and the use of teaching methods and techniques (as well as teaching materials) are becoming important things to consider for hearing impaired students. The math program includes both learning by doing and instructional coaching methods because some students develop their skills with the help of basis of discovery, whereas some others may require a more structured manner of learning (Van Luit & Schopman, 2000).

There is limited research on math teaching to hearing impaired students in Turkey. A survey of previous reports from Turkey (Sarı, 2010), indicates that these research topics have been explored: the effectiveness of math teaching with systematical instructional methods for students with hearing impairment, determination of the goal attainment level of students for preliminary addition (Güzel, 1998), evaluation of skills in solving mathematical problems based on four operations (Güldür, 2005), review of variables that affect math teaching (Tanrıdiler, 2012) and the effectiveness of the touch-math technique to teach in-hand addition to students with Hearing Impairment (Kot et al., 2016). There are few research studies that have focused on the perspective of teachers on the efficacy of their teaching methods, techniques, and materials for teaching math to hearing impaired students. Therefore, there is a need for research on this issue.

### **1.1. Purpose of This Study**

The purpose of this study is to determine how effective different teaching methods, techniques, and materials are for teaching hearing impaired students in math. To this end, the researchers tried to answer these questions:

1. What kind of teaching methods and techniques do teachers of the hearing impaired use for math teaching?
2. What teaching and learning materials in math classes are used by teachers of the hearing impaired?

## 2. Method

This section presents information on the research model, organization of the study group, development of the data collection tools used in this study, the data collection process and the data analysis.

### 2.1. Research Model

This study is a descriptive study about examining the perspective of the teacher on effective teaching methods, techniques, and materials for teaching math to hearing impaired students. This is a qualitative study designed to determine participants' feelings and thoughts in detail about the issue researched.

This study used the qualitative research method known as the "Interview Method." More specifically, a "Semi-Structured Interview Method" was adapted for use in this study. It has been reported that it is possible to determine participants' experiences, attitudes, opinions, intentions and responses by using this interview method (Yıldırım & Şimşek, 2016). A semi-structured interview allows the researcher to investigate aspects of the study using open-ended questions (Karasar, 2015) and it is more flexible compared to other interview methods. In this study, this method was utilized to reveal which teaching methods, techniques, and materials are thought to be effective by teachers who are working in schools for the hearing impaired. Additionally, this study aimed at identifying why teachers preferred specific teaching methods, techniques, and materials for use in classrooms with hearing impaired students.

### 2.2. Study Group

The study group consists of twenty-seven teachers who are working in Schools for the Hearing Impaired. To select the study group, a criterion sampling method (one of the purposive sampling methods) was adapted to define the participants' group. The rationale for the selection of this sampling method was to be flexible enough to work with the array of situations which met a predetermined series of criterion (Yıldırım & Şimşek, 2016). The participants in this study are teachers working at elementary level schools. Before beginning the study, teachers were informed about the topic of study and it was stated that participation in this study was not obligatory, but voluntarily. In this context, this study was conducted with teachers who have accepted the invitation to participate in the study. Table 1 (below) indicates demographic information about the participants of the study.

**Table 1:** Demographic information for participants in this study

Characteristics		N %
Gender	Female	15 56
	Male	12 44
Service years	1-5 years	3 11
	5-10 years	6 22
	10-15 years	4 15
	15-20 years	14 52
Degree information / Education details	Bachelor's degree in special education	19 70
	Bachelor's degree from non-special education	8 30

More than two-thirds of the teachers who participated in the study (15: 56%) are female, while approximately one-third of teachers (12: 44%) we interviewed are male (Table 1). Further, more than one-third (14: 52%) have 15-20 years in service, approximately one-third (6: 22%) have 5-10 years in service, some of them (4: 15%) have 10-15 years and the rest of them (3: 11%) have 1-5 years. Two-thirds of the teachers in this study (19: 70%) have a bachelor's degree in special education, while one-third (8: 30%) have a bachelor's degree from a department that does not have a concentration in special education.

### 2.3. Data Collection Instruments

The data were collected by using "The Semi-structured Interview Form" developed by the researchers of this study. Before the interview questions were written, relevant literature was reviewed and evaluated in detail by the researchers. The prompt of each question was designed to serve the main aim of the study. After the two- main items semi-structured interview form was prepared, each question was presented to three professionals in order to receive their opinions and feedback. The feedback from the professionals was reviewed and the questions on the interview form were revised accordingly. After the interview forms were revised, they were sent to the professionals again for a second round of review. The version of the interview form that incorporated suggestions from the second round of review by the professionals was used for the pilot study. A pilot study was performed on three teachers. After completion of the pilot study, the form was revised again according to their suggestions to make the questions as clear as possible. The final version of the interview form was used in the study with the group of participants who accepted our invitation. During the interview process, the questions below were asked:

1. Which effective teaching methods and techniques to teach the hearing impaired are used in math teaching?
2. Which materials are used in math teaching for the hearing impaired?

### 2.4. Data Collection Process

The purpose of the data collection process was to obtain, detailed information about what effective teaching methods, techniques and materials in math classes are used by teachers of hearing impaired students as well as why the teachers preferred the specific methods, techniques, and materials. Before beginning research, the data acquired from

the study were recorded by tape recorder (to have a complete record) and then the recordings were transcribed after receiving permission from the teachers. In the consent form that the teachers agreed to initially, it was stated that the real names of the teacher participants would not be used in the research and they would not be identifiable. During the interviews, two questions with their prompts were asked to each teacher. Each of the interviews lasted 33-58 minutes.

## **2.5. Data Analysis**

The acquired data from the interviews were analysed using the "Descriptive Analysis Technique". Using this descriptive analysis technique, the data are summarized according to predefined themes. In this analysis, a direct citation is given in order to reflect the views of the interviews in a striking way (Yıldırım & Şimşek, 2016). After completing the interviews with participants, no changes were made in the transcripts and the data acquired from the research were itemised. The answers from the tape recorders were transferred into written form for each question, and then "Master Keys" was used for the interview analysis. This results in the generation of categories consisting of answers to each question. For the calculation of reliability, the formula of  $[(\text{Consensus}/\text{Consensus} + \text{Unconsensus}) \times 100]$  was used. Thus, the researchers and other experts reached a consensus on the whole of the questions. Then, it was counted to calculate frequency and percentage values in terms of views of the teachers were cited directly in the 'findings' sections.

## **3. The Findings**

This section presents participant answers to the interview questions on effective teaching methods, techniques, and materials for students with hearing impairment in math teaching.

### **3.1. Effective Teaching Methods and Techniques in Math Teaching for Students with Hearing Impairments**

Two-thirds of teachers (18: 67%) who participated in the study stated that they used drama and educational games. The teachers also stated that teaching a lesson in a verbal way was difficult and they could use drama and educational games more effectively for hearing impaired students. Further, the teacher responses indicate that students could learn mathematical concepts more easily with the use of drama or educational games because of difficulties in being able to explain abstract concepts with using verbal communication. In addition, teachers said that they thought teachers should use mostly visual materials in math teaching, and they added that when they used visuals as much as possible and when they included the materials which are available in class environments, students could learn more quickly. According to the participants of this study, learning can be broken down into stages. At stage one, the most effective teaching should be made with real objects and abstract concepts should be changed into

tangible forms. This is because hearing impaired students are more likely to have weak skills for understanding abstract concepts. At the second stage, abstract concepts should be introduced. Teachers thought that when they used drama and educational games, mathematical concepts could be learned much easier because these students did not know the Turkish verbal language well. These teachers indicated that experiential instruction in the classroom (for example; a games or drama activities) would be more beneficial. Further, according to these teachers, student perception was one of the reasons for using drama techniques as training techniques in math teaching. They stated that in the teaching of rhythmic counting and addition problems, the teachers were able to use these methods very effectively. The quotations from the views of teachers taken from the transcripts are presented below:

*"Well, drama is a direct technique. When we asked that "why drama?", because the perception of hearing impaired children is weak. Explaining some abstract concepts is difficult so we try to explain these concepts with drama. For instance, when I teach addition, some students become a tree. They hold apples in their hands. Another child picks the apples. We make role play like that. Numbers are visualized with apples" (T2).*

*"First of all, we give mathematical concepts a place at our classroom walls. There are figures, numbers with figures, written form of numbers and schedules showing "how many". Children see them in the classroom. I have also immigrant children in my class. Their understanding is much more difficult than our students' understanding. They are learning rhythmic counting little by little in various activities such as games, finger games or hopscotch" (T5).*

Approximately one quarter of teachers (6: 22%) stated that they used the method of matching as a teaching method in the math classroom. Teachers said that, in general, they had difficulties in math lessons where many students in their classes had total hearing loss and the students did not have hearing aids (and, in some cases, the student's parents were immigrants). It is possible that learning outcomes were poorer in these classroom circumstances because the teachers stated that they did not use verbal teaching methods such as discussion and question-answer techniques due to the fact that the students had total hearing loss. Teachers also said that not knowing which students knew sign language made effective teaching difficult. Teachers expressed that the same quality of education was given to immigrant children in class but these children remained unresponsive. The matching method provided students with an opportunity to visualize the lesson and therefore it was thought that this method would be preferred and the easiest to communicate mathematical concepts. When numbers - which are abstract concepts- were provided with visual images or lines and when number-object matching was done, students comprehended maths more quickly. These teachers stated that when they observed students performing addition and subtraction tasks, the students frequently used the matching method. Furthermore, according to the

teachers we interviewed, teaching methods and techniques used to teach math to children with full hearing were the same as those used for children with hearing impairment. For this reason, teachers have come to the conclusion all children can learn maths with the assistance of visuals. So even though hearing impaired students can be taught math similarly to students with full hearing, students with hearing impairment still need to be separated because all of the methods and techniques used for children with hearing are not appropriate for children with impaired hearing. Quotations from teacher transcripts appear below:

*"My class is a total deaf class. I have four students; all of them immigrant students. Therefore, we cannot use spontaneous auditory, verbal method in class. Because, most of the children have no hearing aids. If they have even one, they cannot use it properly. Obviously, they do not know sign language. We cannot frequently use verbal methods such as discussion, question-answer" (T27).*

*"Children learn the numbers of 1-2 numerically. Their most successful subject is mathematics in comparison with reading-writing or speaking language. In respect of methods and techniques that we have used, we are currently providing numbers, asking them to match numbers with their written forms and counting these numbers. But, we have also problems with that. Because children is counting from right to the left direction, in other words, in a way of quite opposite of us, therefore children experience failures in some activities which include to find equivalents of numbers in a written form" (T6).*

*"Numbers are not involved directly in visuals and abstracts. It can be somewhat different but they are like concrete. Because, for example, we write 2 under the number of 2, then you are drawing some visuals next to the number and you are making number-object matching. This is same as normal children who begin school recently" (T23).*

*"We are using same methods and techniques. When we come to the addition and subtraction, we are making number-object matching. We don't need these in multiplication and division, but as I said, we are not following different methods than that are used for normal children in math teaching" (T8).*

Some of the teachers who participated in the study (3:11%) stated that they used the methods of modeling and demonstration. These teachers said that after the teaching lesson, they made practices and used modeling in analysing questions. According to these teachers, after students were shown how to solve the question, it was quite beneficial to ask the question and provide the students time to work on the answer to the question by themselves. Through the use of this method, students see their faults and mistakes. In addition, this method might have been so effective because the teachers often modeled the method with content from educational websites. Quotations by teachers from the interviews are presented below:

*"I am using modeling method as a teaching method. Firstly, I am demonstrating how to solve the question. Then, in this sense, I am asking a question and allowing them to do by themselves. After that, if they make a mistake, I repeat the question and we correct the wrong answers. In other words, it is being applied. There is eba.gov.tr. There are also another web-sites related with mathematics. Lecturing is available over there. I am getting watched from there and if there are interactive activities, I am getting these activities done. It is same as Mebvitamin" (T10).*

*"My students are completely total deaf. The method of demonstrations is more appropriate to them. First of all, I am giving some sampling, then I show what they are going to do. After that, I am asking the question. When they make mistakes, we are correcting, at least they see their mistakes. Then, I am asking same type of question in order to understand their mistakes" (T19).*

### **3.2. Materials Used in Math Teaching for Hearing Impaired Students**

Most of the study participants (14: 52%) stated that they prepared the materials used in class activities on their own. According to these teachers, education materials used for hearing impaired students are limited in the market. Furthermore, in the cases when teachers could locate desired materials for use in their classroom, they could not procure the materials due to high cost. The teachers said that they used the internet to help them prepare materials for class. They indicated that for lessons that required a substantial amount of materials, it took a lot of time to prepare. Further, teachers stated that when they design their own materials the materials are more effective because not all of the available pre-designed materials are goal-oriented and an exact fit for the needs of the class. The teachers thought that if two teachers are available in the classroom, the workload should be decreased and that would give the teachers enough time to design materials. In summary, the availability of visual and auditory materials for the education of hearing impaired students are limited. Quotations from the teachers we interviewed are presented below:

*"We are preparing materials in the school. The materials that we saw in the web and that we can apply. We are preparing them and attaching them to class walls. We are preparing some pictures that demonstrate shapes such as triangles, circles, squares and their perimeters. Students are cutting and passing by themselves and writing their names on it. For example, I asked them to draw triangle by giving them peripheral lengths. Then, we bought a rope. We enclosed triangle with rope and we measured length of rope. Therefore, we found exact perimeter" (T11).*

*"Materials that we used should be visual materials. I am preparing by myself. Because, we cannot find materials for hearing impaired children in the market. Even we find, they are too expensive. We cannot access these materials easily. Obviously, designing materials is a hard work. It requires too much time and also manual skill. How should I*

*know, as a result, everything that is designed are not goal-oriented. In my opinion, if there are two teachers available in classes, somewhat responsibility may be decreased. Time remains for preparing material" (T16).*

A third of the teachers (9: 33%) said that textbooks should be used in math teaching as a material, but it was not possible. These teachers indicated that the available textbooks were not appropriate for hearing impaired students because the available textbooks have material that is too advanced. Furthermore, teachers felt that the pictures and diagrams in the textbooks were not helpful enough and there was too much text to be helpful. These teachers recommend that publishers increase the number of books available for hearing impaired students, especially books that focus on basic mathematics concepts. From this section, we conclude that there is a deficiency in resources for teaching hearing impaired students. Quotations by teachers from the interviews are presented below:

*"We have to consider about visuality. Therefore, I use textbooks. I am trying to provide visuality with the help of pictures in these books. Here, the important thing is that satisfying the needs of children. Learning numbers is a need for children. I can use books in this sense but it remains insufficient. Contents are not appropriate" (T18).*

*"Textbooks given to us in the curriculum of elementary school are not appropriate. Original materials are very important. There are artificial ones. For example, in the concept of weight, concepts such as weighing and measuring are being practiced with original materials. Everything is with pictures and visuals. Such books are required for us. Levels are too low in our classes. We are second grade at this year but we haven't got through in-hand addition and subtraction yet. We are in basic level of rhythmic counting. Books are important resources but we cannot use them" (T1).*

Fifteen percent of the teachers interviewed said that the math teaching materials used for children with normal hearing could also be used for hearing impaired students. Abacuses, number bars, beans and puzzles were utilized by teachers to provide concrete examples of math concepts in the classroom. Additionally, these teaching materials help reinforce concepts discussed in class. Some teachers said that they used apples and walnuts as teaching materials which they then served to the students for a snack. From this, we conclude that there is a lack of visual and auditory materials for teaching maths to hearing impaired students. Quotations from the teachers are presented below:

*"There are puzzles, puzzles related with numbers. We are trying to teach numbers and signs in this way. For example, I bring walnuts. We are doing addition with them, then we are eating them together in the class. Important thing is making concrete each item taught to them" (T12).*

*"We are using all materials that are used with almost normal children. Number bars, wood sticks, beans, abacus. First, we are teaching addition like: "take 7 sticks; now take 3 more. Add, what is the result?" (T15).*

#### **4. Discussion**

Taking into account all of the data gathered in this study, teachers mostly rely on the use of drama while teaching math to hearing impaired students. Additionally, visualization is valued in teach math because students with hearing impairment are likely to have some perception problems and difficulties understanding some abstract concepts. From the interviews, it was clear that the teachers think that drama helps students comprehend math concepts in teaching math. Another advantage of using drama to teach math is that it encourages active learning by using money, weighing things, measuring items. Tanrıdiler (2012) emphasized that selected activities should be related to daily life activities in order to make the experience more meaningful to the students and appear more useful. Similarly, Sarı (2010) revealed that teachers working with hearing impaired students should consider the use of concrete visualization strategies along with practical activities. Dramatizing learning experiences by using materials provides opportunities for hearing impaired children to learn through symbolic play and create an environment for communicative skills such as dialogue, interpretation and questioning (Yücel, 2014). However, for drama to be used as an effective method for these students, they need a strong vocabulary. Kazelskis's (1999) study on pedagogical techniques for the hearing impaired revealed two different attitudes towards mathematics. Teaching techniques that the students prefer improve their attitudes about learning and result in greater comfort with the academic material and, ultimately, leads to increased success. Teaching techniques which students dislike may inspire fear and discomfort, which can be difficult to overcome. In class, there are some bilingual children and of these children who do not know the Turkish language well, this style causes them to experience learning difficulties. Therefore, if a student is a foreigner who cannot speak and understand Turkish language and does not use hearing aids then the student is likely to have difficulties succeeding in math, even if he/she is exposed to the drama method. Therefore, it is recommended that foreign students who are hearing impaired should be taught the Turkish language before the teachers delve deep into other academic subjects like math. It is likely that the demonstrating method is an effective technique for teaching hearing impaired students because it utilizes visual materials. The reason teachers prefer to use this method is that some of the hearing impaired students are bilingual and do not know Turkish language well, which makes communication even more difficult. Another method that teachers prefer to use in the classroom is modeling and demonstration. This technique allows teachers to demonstrate their expertise by showing students exactly what they need to know (Ünal, 2017). Hyde et al. (2003) discuss that experience is important to acquire problem- solving skills for hearing impaired students and modeling by the teacher has

a positive effect on students acquiring problem-solving skills. Therefore, this study indicates that there are various teaching methods that teachers cannot use effectively for teaching math to students with hearing impaired. Some techniques such as problem establishing and solving, discovery, cooperative learning are not commonly used by the teachers possibly due to the fact that most of the teachers who work with hearing impaired students come from out of the special education field and these teachers have little practice using these teaching methods and techniques in practice. Furthermore, teachers who have been trained outside of the special education field often do not know sign language so it can be a barrier to employing some teaching methods and techniques effectively in the classroom.

One interesting finding of this study is that teachers use materials which they prepare on their own. When selecting materials, teachers prefer those that are concrete, tangible and help students learn skills applicable to daily life. Heddens (1986) claims that since all mathematics problems come from the real world, a real situation where the math knowledge can be used must be translated into the symbolism of learning mathematics. This situation demonstrates that teachers should emphasize concrete materials that help students visualize. The reason on why teachers prefer to use these materials can be explained with the expanding availability of these materials. Arnold (1997) states that the balance between language and visual imagery should be changed for the hearing impaired at a certain stage of the mathematical learning process. Arnold (1997) discussed that teachers thought that when numerical concepts were taught visually, the students had increased comprehension. Similarly, Kelly & Mousley (2001) discussed that hearing impaired students were successful at solving problems using graphs. Nunes & Moreno (2002) also reported that although mathematical concepts were spontaneously learned by hearing children in daily life, hearing impaired students could learn them through pictures and diagrams; Gürgür, Akçamete & Vuran (2005) discussed the same issue saying that the most successful lessons of students with hearing impairments were mathematics, and that tangible, and visual materials increased their success; Kot et al. (2016) found that the touch math technique had positive results in the education of students with hearing impairments because this technique appeals to a student's visual sense. Antia, Stinson & Gaustad (2002) stated that if the teachers designed instructional materials and provided actualization and evaluation of learning with the help of these materials students could learn the subject more easily. If students were provided with ready-to-use materials for the hearing impaired, then teachers could spend more time designing additional materials tailored to the contents of subjects. Teachers expressed that it might be impossible to design all materials as goal-oriented and creation of materials was an occupation which required some specific skills and time. These teachers said that only some of the same materials used to teach math to children with hearing could be used on students with impaired hearing. Although the use of materials is critically important for good learning outcomes, the hearing impaired students, who also need special education, were unable to use the materials at the desired level. Thus, this study found that although teachers

of the hearing impaired emphasized the use of various visual and auditory learning materials, they often did not have extensive materials because they need more time to prepare materials for class.

## **5. Results and Implications for Practice**

In this section, the results of the study are discussed and implications for practice are presented.

### **5.1. Results**

The results raised from this study are;

- 1) The teaching methods and techniques in math teaching which the teachers should use with hearing impaired students are limited. In some classes, teachers do not know sign language and also in some classes, students do not know sign language, and it results in limited communication.
- 2) In classes with many bilingual students that are hearing impaired and do not know the Turkish language well, teaching is very difficult.
- 3) Some of the teachers who are working in the primary school for the hearing impaired, were not educated in special education so they lack some effective teaching methods and techniques in math teaching.
- 4) It can be concluded that teachers should use objects in math teaching which should be visual, tangible and related to real life. However, teachers' abilities in Turkey to prepare materials are not at the expected level and there are a limited amount of materials available in classes.
- 5) The obligation for teachers who have to design materials for each class causes exhaustion of teachers and also the rate of usability of related materials are very low.
- 6) Although teachers recognize that textbooks as an important material, they often cannot find math textbooks that are at the appropriate level and that nicely use visual components.

### **5.2. Implications for Practice**

In this section, we discuss how implications of this study can be used in practice.

- 1) The content of the math books sent to schools free by the Ministry of National Education on the purpose of utilizing books which are important for teachers and the students however, visual resources for teachers increase visibility and make them understandable for the hearing impaired,
- 2) For providing various materials that should be used for hearing impaired students in math teaching, it has to be worked in cooperation with the Ministry of National Education and private institutions,

- 3) Some courses should be arranged for teachers of the hearing impaired on the issue of how to prepare visual and concrete materials and how to overcome difficulties faced by the teachers to be able to teach math subjects in practice,
- 4) In-service training for the teachers should be organized for teachers to increase their professional skills in using teaching methods and techniques effectively.

### 5.3. Suggestions for Future Studies

In this section, suggestions for future studies are presented.

- 1) This study was designed with the aim of learning teacher views on methods, techniques, and materials used to teach hearing impaired students math. In future studies, we would like to focus on the difficulties that the teachers in math teaching face and find ways to investigate solutions to these problems.

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