Development of Assistive Technology Lesson Exemplar for Grade 7 Learners with Difficulty in Hearing

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Abstract

This study determined the least mastered competencies of Grade 7 learners with difficulty hearing in Mathematics as the basis for developing the assistive technology lesson exemplar. Purposive random sampling was used. Teacher-made tests and validated researcher-made tests were administered. Suggestions were noted from focused group discussions. The assistive technology lesson exemplar developed was the multimedia that uses American Sign Language in the videos, closed captioning, videos, math manipulatives, and ICT applications during classroom activities. The assistive technology lesson exemplar developed was acceptable in all experts' categories. The level of competencies in Mathematics of Grade 7 learners with difficulty in hearing did not meet the expectations based on the K to 12 grading system. The level of competencies in Mathematics of Grade 7 learners with difficulty hearing are below their peers in mainstream education. Using the SETT framework and WATI Assistive technology checklist helped determine the appropriate assistive technology lesson exemplar. The assistive technology lesson exemplar developed was of great help to Grade 7 learners with difficulty in hearing in Mathematics.

Keywords: assistive technology, lesson exemplar, competencies, Mathematics, learners with difficulty in hearing.

1. Introduction

Everyone has the right to a decent education with the same academic level and content as hearing students, including those with hearing loss, including children who are hard of hearing. They have a right to get a primary education in a language and setting that fosters their potential.

Maltzan (2005) reported that "deaf learners' performance on problem-solving tasks and word problems falls below that of their hearing counterparts". Scaffolding strategy in teaching Mathematics affects learners' performance and attitude (Casem, 2013). Thus, assessing the Mathematics performance of learners is the basis for enhancing instruction (Capate, 2005). These studies supported the need of learners with hearing impairment for assistance in Mathematics. They prompted the researcher to study more on assistive technology using scaffolding instruction to enhance learners' performance.

The main ideas of Vygotsky's Theory are that social interactions are essential, that self-regulation develops through the internalisation of actions and mental processes in social interactions, that language is the most crucial tool, and that cultural transmission of tools like language and symbols causes human development. Social communication is followed by private speech and covert or inner speech as language evolves. What children can do on their

own and what they can do with help from others is known as the "zone of proximal development (ZPD)". Cognitive growth is aided by interactions with adults and peers in the ZPD (Schunk, 2012). In this study, social interaction in classroom activities was given emphasis.

2. Literature Review

2.1. Characteristics of Individuals with Difficulty in Hearing

Characteristics of individuals with difficulty in hearing can vary based on the age of onset of the hearing loss, the degree and type of hearing loss, the family's primary language and the developmental experiences of the learner (Taylor, 2009)—the learner's environment at home matters. The family members may be a part or not of the Deaf culture and community. Communication among family members was of utmost importance. The primary language was American Sign Language.

The Deaf community have the following cultural characteristics: 1) a distinct language (ASL), 2) a distinct tradition and individuals with difficulty in hearing has history, distinct social institutions like churches or sports team for individuals with difficulty in hearing, distinct schools like SPED, and social protocols like using touch to gain attention and leaving the room (Taylor, 2009).

2.2. Educational Approaches

An individual with hearing loss can be educated using one of three methods: oral/aural, total communication, or bilingual-bicultural. The oral/aural approach emphasises talking and emphasises amplification, auditory training, speech reading, technology, and talking more. For whole communication, speech is used with contemporaneous manual signals, such as signs and fingerspelled English words. In the bilingual-bicultural method, "American Sign Language (ASL)" is employed as the instruction language, and deafness is seen as a cultural and linguistic difference (Heward, 2013).

Constructivism is used by people who are deaf or hard of hearing to learn. The cognitive education viewpoint, a constructivist view of learning founded on Feuerstein's theories, is an example of this method. The "Mediated Learning Experience (MLE)" Theory is related to Feuerstein's Theory. The mediation of intention and reciprocity; the agreement on the work's intention between the mediator and learners; mediation of transcendency; the growth of thinking beyond the here and now; and mediation of meaning are the critical elements of a mediated learning experience. MLE is a component of Feuerstein's Dynamic Assessment approach, which reveals a person's learning potential by evaluating their cognitive potential in youngsters. From the standpoint of mathematics education, analytical learning, problem-solving, and communication are essential for advancing mathematical knowledge. Deaf students require more time to learn mathematics than hearing students do; as a result, they may pick up on some ideas later than hearing students and take different paths to understanding (Foisack, 2003).

Education for deaf students involves "mediated instruction or learning through sign language interpreting. Then, it is important to focus on the multitasking of DHH ("Deaf/Hard of Hearing") students. According to studies, DHH students are less likely than hearing students to infer relationships between concepts or numerous input dimensions when reading or solving problems. They are also less likely to immediately process these relationships.

Standardised and non-standardised measures are used to evaluate students' knowledge of algebra, geometry, measuring, and problem-solving. Robust data suggests that D/HH learners' difficulties with maths may start before formal schooling. Additionally, results indicate that these kids have regions of geometry strength and areas of measurement and problem-solving weakness. Evidence of poor performance throughout foundational stages may be related to academic success later (Marschark, 2008).

Deaf students are taught mathematics in a trilingual setting combining national, sign, and mathematical languages (Vitovaa, 2013). "Filipino, the mother tongue, American/Filipino Sign Language, and the language of mathematics" are all employed in the Philippines in a trilingual environment. Students who are deaf can use assistive technology to aid them with maths.

2.3. Assistive Technology

Assistive technology is technology devices that help individuals with disabilities adapt to the natural environments of the family, school, and home (Hardman, 2012). According to Heward (2013), IDEA defines assistive technology as the equipment children can use and the services required to help them get them.

Any item, piece of equipment, or product system that is utilised to increase, maintain, or improve a child with a disability's functional skills is considered an assistive technology device, according to Heward (2013).

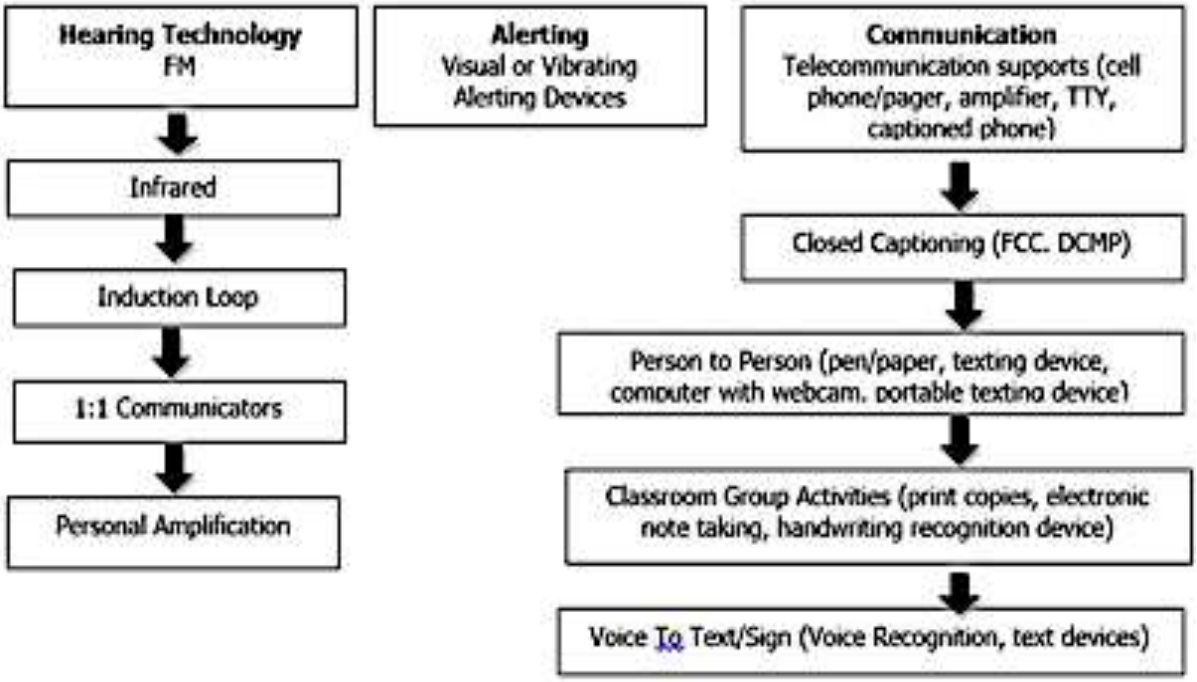
Any service that directly helps a kid with a handicap decides on, purchase, or use an assistive technology service is considered an assistive technology service. (Heward, 2013)

"There are many types of assistive technology for deaf learners which include:

- Assistive listening devices (ALDs) – ALDs amplify sounds, allowing deaf and hard-of-hearing learners to hear sounds even when there is a lot of background noise.
- Augmentative and alternative communication (AAC) devices help hard-of-hearing learners express themselves better.
- Alerting devices – Alerting devices connect to alarms, doorbells, or telephones that emit a loud sound or light to let deaf learners know that an event is occurring.

Figure 1 shows a continuum of considerations for assistive technology for individuals who are deaf or hard of hearing" (Heckendorf,2009).

Figure 1: A Continuum of Considerations for Assistive Technology for Individuals who are Deaf or Hard of Hearing



2.4 Learning through Assistive Technology

According to a descriptive study by Farooq (2015), no substitute for these devices may provide students with hearing impairment with individualised support. The mean difference in learners' learning revealed that assistive technologies are generally helpful for these students. Much attention has been paid to the function of high-tech and low-tech assistive devices. According to Netherton (2006), students in professional and technical education classes can encounter new chances and vistas by recognising that teachers frequently have the knowledge, abilities, and resources to deliver excellent learning experiences for kids and by utilising assistive technologies.

When creating the textbook, Retnawati (2015) took into account the content criteria for students who are hard of hearing, in particular those in junior high school, as well as their unique needs. The use of technology, such as computers and calculators, as a learning aid for mathematics is discussed in the textbook. The use of assistive technologies helps these students succeed in maths. According to Erdem (2017), many different forms of assistive technology are utilised in special education, and these technologies generally benefit special education students.

Devices that can help kids with special needs have been developed more effectively thanks to computer technology. The cost of technology is a significant concern for the school, and many instructors need to be adequately trained on how to use it in their classes (Hasselbring, 2000).

According to Tanridiler (2017), balanced mathematics instruction (BMI) has improved the study's participants' students. The study adds to the related literature and develops a framework for instructing mathematics to hard-of-hearing students. The work is also anticipated to add to the mathematical curricula that will be created for deaf students in

Turkey. According to Nusir (2012), interactive augmented learning can be a valuable complement to conventional education.

Because it intends to create instructional materials that are accessible and employ "Greek Sign Language (GSL)" as the significant access method, the study by Kourbetis (2013) is comparable to this study. For learning reasons and for teaching and instructing sign language and sign language, educational software is a fantastic tool for both the learner and the teacher. The software has been incorporated into the educational process for Deaf students, and the evaluation by the educational community has shown that it is a fun and exciting addition to traditional study techniques. In several nations, technology has been created to capture books being read aloud in sign language and translated into a digital document with synchronised multimedia elements. The emphasis is on creating best practices and standards to be adhered to while designing, creating, and documenting GSL content.

According to research, a complex interplay of various elements leads to "deaf and hard-of-hearing (DHH)" students' academic success. These variables comprise learner traits, familial contexts, and experiences within and outside the classroom. The conclusions significantly impact DHH learner education policy and practice and how past research is interpreted (Marschark, 2008).

3. Purpose of the Study

This study attempted to determine the least mastered competencies of Grade 7 learners with difficulty hearing in Mathematics.

"Specifically, this study sought answers to the following questions:

1) What are the least mastered competencies of Grade 7 learners with difficulty hearing in Mathematics based on the level of competencies?
2) What is the appropriate Assistive Technology lesson exemplar to be developed for Grade 7 learners with difficulty in hearing in Mathematics based on the SETT framework and WATI assessment?
3) What is the level of acceptability of the assistive technology Lesson Exemplar that was developed in terms of a) Content, b) Instruction Quality, c) Presentation and Organisation, d) Assessment and e) Special Accommodation?"

4. Significance of the Study

This study may benefit the Teachers, SPED educators, SPED Teachers, learners, School Administrators, and researchers. This study will help teachers, SPED educators and SPED Teachers to be aware of the competencies of learners with difficulty in hearing and what they will do to improve their performance in Mathematics. This study will let the learners experience other means of learning and make them aware of their competencies. The administrators can make use of the findings of the study as a means of improving students' academic performance. This study will be an eye-opener for those who want to know more about hearing and learning and will be an avenue for further research.

5. Methodology

5.1. Research Design

This study utilised a mixed method design - descriptive and qualitative research design. Descriptive research is done to determine the least mastered competencies from the levels of

competencies of the Grade 1 Mathematics curriculum. Then a focused group discussion was done to choose the topic to be the content of the assistive technology lesson exemplar. Development of the Assistive technology lesson exemplar follows. The experts in Mathematics and Special Education evaluated the assistive technology lesson exemplar. A purposive sampling technique was used in the study.

5.2. Participants

This study's participants are Grade 7 learners with difficulty hearing SPED.

5.3. Instrument

The data gathering instrument used is a teacher-made test to determine the level of competencies and a validated researcher-made test on the least mastered. The SETT framework was applied by checking the needs of the students in terms of Student, Environment, Tasks and Tools. The WATI Assistive Technology Assessment Checklist was used to determine the appropriate assistive technology.

5.4. Data Gathering Procedure

A purposive sampling technique was used in the study. A teacher-made test was conducted to get the level of competencies in Mathematics. Then the topics in the identified quarter were given a researcher-based test.

5.5. Data Analysis

The following statistical tools were employed in the description and analysis of the gathered data:

1) Frequency count was used to determine the number of cases that belong to a learning competency.
2) Per cent was used to express the ratio of the score obtained in an item/component to the total score for the item/component. This analysis was also used to express the relative frequency of responses in a particular option in the test.
3) Mean. This tool was used to reflect in a single value the overall performance of the respondents in a particular item, area, or entire component of the research instruments.
4) Standard Deviation. This statistical measure was used to describe the variability or dispersion of test scores from the mean.
5) The SETT Framework and WATI Assessment Checklist used a frequency count to determine the learner's needs.
6) The researcher used Microsoft Excel Data Analysis Package for each learning competency's mean and standard deviation.
7) Then SPSS was used to test the reliability of researcher-made tests.

6. Results and Discussion

Level of Competencies of Grade 7 Learners with Difficulty in Hearing in Mathematics

The frequency, mean, standard deviation, per cent of the correct answer and the level of competency for each learning competency was computed. The level of competency was based on Table 1, as suggested by the Department of Education last 2015. The level of competencies of Grade 7 learners with difficulty in hearing in Mathematics is shown in Table 1

Table 1. Level of Competencies of Grade 7 Learners in Mathematics

Learning Competency	frequency	Mean	Standard Deviation	Per cent of Correct Answer	Level of Competency
Differentiates between algebraic expressions and equations.	1	0.05	0.23	5	Did Not Meet Expectations
Describes the development of measurement from the primitive to the present international system of units.	1	0.05	0.23	5	Did Not Meet Expectations
Performs operations on rational numbers.	2	0.11	0.32	11	Did Not Meet Expectations
Estimates the square root of a whole number to the nearest hundredth.	2	0.11	0.32	11	Did Not Meet Expectations
It uses Venn Diagrams to represent sets, subsets, and set operations.	2	0.11	0.32	11	Did Not Meet Expectations
It uses Venn Diagrams to represent sets, subsets, and set operations.	2	0.11	0.32	11	Did Not Meet Expectations
Represents real-life situations which involve real numbers.	2	0.11	0.32	11	Did Not Meet Expectations
Approximates the measures of quantities.	2	0.11	0.32	11	Did Not Meet Expectations
Multiplies and divides polynomials.	2	0.11	0.32	11	Did Not Meet Expectations
Illustrates the different subsets of real numbers.	3	0.16	0.40	16	Did Not Meet Expectations
Describes principal roots and tells whether they are rational or irrational.	3	0.16	0.40	16	Did Not Meet Expectations
Translates English sentences to mathematical sentences and vice versa.	3	0.16	0.40	16	Did Not Meet Expectations
Solves problems involving algebraic expressions.	3	0.16	0.40	16	Did Not Meet Expectations
Solves linear equation or inequality in one variable involving absolute value	3	0.16	0.40	16	Did Not Meet Expectations
Arranges real numbers in increasing or decreasing order.	4	0.21	0.46	21	Did Not Meet Expectations
Evaluates algebraic expressions. Evaluates algebraic expressions for given values of the variables.	4	0.21	0.46	21	Did Not Meet Expectations
Differentiates between constants and variables in a given algebraic expression.	4	0.21	0.46	21	Did Not Meet Expectations
Describes well-defined sets, subsets, universal sets, and sets' null set and cardinality.	5	0.26	0.51	26	Did Not Meet Expectations
Represents the absolute value of a	5	0.26	0.51	26	Did Not Meet

Learning Competency	frequency	Mean	Standard Deviation	Per cent of Correct Answer	Level of Competency
number on a number line as the distance of a number from 0.					Expectations
Illustrates the union and intersection of sets and the difference between two sets.	5	0.26	0.51	26	Did Not Meet Expectations
Illustrates what it means to measure.	5	0.26	0.51	26	Did Not Meet Expectations
Finds the solution of a linear equation or inequality in one variable.	5	0.26	0.51	26	Did Not Meet Expectations
Uses models and algebraic methods	5	0.26	0.51	26	Did Not Meet Expectations
Arranges rational numbers on a number line.	6	0.32	0.56	32	Did Not Meet Expectations
Represents the absolute value of a number on a number line as the distance of a number from 0.	6	0.32	0.56	32	Did Not Meet Expectations
Converts measurements from one unit to another in both Metric and English systems.	6	0.32	0.56	32	Did Not Meet Expectations
Interprets the meaning of a raised to n where n is a positive integer.	6	0.32	0.56	32	Did Not Meet Expectations
Differentiates between equations and inequalities	6	0.32	0.56	32	Did Not Meet Expectations
Adds and subtracts polynomials.	6.5	0.34	0.58	34	Did Not Meet Expectations
Expresses rational numbers from fraction form to decimal form and vice versa.	7	0.37	0.61	37	Did Not Meet Expectations
Determines between what two integers the square root of a number is.	7	0.37	0.61	37	Did Not Meet Expectations
Plots irrational numbers (up to square roots) on a number line.	7	0.37	0.61	37	Did Not Meet Expectations
Translates English phrases to mathematical phrases and vice versa.	7	0.37	0.61	37	Did Not Meet Expectations
Illustrates linear equations and inequality in one variable.	8	0.42	0.65	42	Did Not Meet Expectations
Solves problems involving real numbers.	8.5	0.45	0.67	45	Did Not Meet Expectations
Solves problems involving sets.	9	0.47	0.69	47	Did Not Meet Expectations
Solves problems involving conversion of units of measurement.	9	0.47	0.69	47	Did Not Meet Expectations
Solves problems involving equations	9.5	0.50	0.71	50	Did Not Meet

Learning Competency	frequency	Mean	Standard Deviation	Per cent of Correct Answer	Level of Competency
and inequalities in one variable.					Expectations
Performs fundamental operations on integers.	10	0.53	0.73	53	Did Not Meet Expectations
Writes numbers in scientific notation and vice versa.	10.5	0.55	0.74	55	Did Not Meet Expectations

Based on Table 1, the level of competencies of Grade 7 learners with difficulty in hearing is less than 75%, meaning it "Did Not Meet Expectations". This result validated the study of Maltzan (2005) that deaf learners' performance on problem-solving tasks and word problems falls below that of their hearing counterparts. Therefore, there is a need to meet this gap.

Based on Table 1, the least mastered competencies were those competencies with the lowest percentage of correct answers in the Quarter 1 and Quarter 2 exams. The top six topics were chosen. The least mastered competencies of Grade 7 learners are the following for Quarter 1 1) Estimated the square root of a whole number to the nearest hundredth, 2) Uses Venn diagrams to represent sets, subsets and set operations, 3) Performs operations on rational numbers, and 4) Represents real-life situations which include real numbers. The learning competencies for Quarter 2 were 1) Illustrate linear equations and inequality in one variable and 2) Solve problems involving conversion of units of measurement. The content to be included in the lesson exemplar will be Uses Venn diagrams to represent sets, subsets and set operations.

Needs of the Grade 7 Learners with Difficulty in Hearing in Terms of Student, Environment, Tasks and Tools for Assistive Technology Lesson Exemplar

For the assistive technology lesson exemplar developed, the performance of the Grade 7 students was determined by using the SETT framework. The SETT framework was applied by checking the needs of the students in terms of Student, Environment, Tasks and Tools.

Student or Learner's Needs

The learner's needs having the highest frequency were follow-up or review, ASL to communicate, study the four fundamental operations, behaviour and improve problem-solving skills. The primary need of Grade 7 learners with difficulty in hearing was follow-up and review. This study confirmed a study of Yilmaz that learners' tasks are analysed and then broken down into smaller steps and chunks to help learners organise information. Deaf learners need more time and simplification of problem-solving to learn Mathematics than hearing learners, as Foisack discovered in his study. The scaffolding teaching strategy can improve the Mathematics performance of high school students, as suggested by Casem.

The Grade 7 learners with difficulty in hearing must use ASL to communicate in the classroom. Marschark confirms that Deaf learners are educated via "mediated instruction" or learning through sign language interpreting. In the bilingual-bicultural approach, deafness is viewed as a cultural and linguistic difference, and American Sign Language (ASL) is used as the language of instruction (Heward, 2013). In the Philippines, a trilingual environment is used - Filipino or mother tongue, American/Filipino Sign Language and the language of Mathematics, which makes learning more complicated. Thus, more considerations are taken

care of for the Grade 7 learners with difficulty in hearing, which was called accommodation in SPED.

Since learners need more time in problem-solving in mathematics, then the learner has to study more on the four fundamental operations. Many factors in the academic performance of Grade 7 learners with difficulty in hearing included characteristics of the learners, characteristics of their family environments, and experiences inside and outside school. These contributed to the behaviour of Grade 7 learners with difficulty in hearing. Table 2 shows the needs of Grade 7 learners with difficulty in hearing.

Table 2. Student's or Learners' Needs

STUDENT or LEARNER	frequency
ASL to communicate	4
study on the four fundamental operations	4
behaviour	3
attendance	1
follow up or review	11
guidance	1
poor in gathering information	1
attention	1
study	2
improve problem-solving skills	1

Environment Needs

The environment needs of Grade 7 learners with hearing having the highest frequency were regular sitting, peer tutoring or group discussion, family support, teacher and materials like books, pictures and charts. Schunk can achieve peer tutoring by supporting learning by conversing and intellectual partner to support learning by reflecting. Thus, interactions with adults and peers in the ZPD promote cognitive development authenticates Schunks' study. The factors that affect the academic performance of Grade 7 learners with difficulty in hearing are characteristics of the learners, characteristics of their family environments, and experiences inside and outside school. These contributed to family support. ASL is a visual or gestural language with no vocal element. The Deaf culture promoted an environment that supports vision as the primary sense used for communication at school, in the home, and the community. Thus, pictures and charts can help Grade 7 learners with difficulty in hearing in learning Mathematics.

Table 3 shows the environmental needs of Grade 7 learners with difficulty in hearing in learning Mathematics.

Table 3. Environment Needs

ENVIRONMENT	frequency
regular sitting	17
peer tutoring	9
family support	2
group discussion	1
physical assistance	1
assistance	1
teacher	2
focus on studies	1
materials like books, pictures and charts	1

Task Needs

The task needs of Grade 7 learners with difficulty hearing having the highest frequency were follow-up or review lessons, behaviour management, class attendance, work by pair or group, more activities and tutorial discussion. Learners' tasks are analysed and then broken down into smaller steps and chunks to help learners organise the information discussed in the study of Yilmaz. Deaf learners need more time and simplification of problem-solving to learn Mathematics than hearing learners, as Foisack discovered. Thus, simple examples and activities for the learners. Deaf people have their own culture. This activity includes the specific rules of behaviour in communication, like turn-taking rules. Children with severe to profound hearing loss often feel isolated and unhappy in school when socialisation with peers is limited. Teachers need to be aware of the characteristics and expectations of their learners in schools so that he/she can deal with the behaviour of the learners. Teachers' reflections are vital to the development of the learner. Table 4 shows the Task needs of the Grade 7 learners with difficulty in hearing in learning Mathematics.

Table 4. Task Needs

TASK	frequency
follow up or review the lesson	10
behaviour management	9
attendance	2
guidance	1
more activities	1
communicate	1
work by pair	1
work by group	1

tutorial type	1
calculator	1
chart	1
diagrams	1

Tool Needs

Another thing to consider is the tool needs of the learners. The tool needs having the highest frequency were pictures, charts, examples, calculators, graphs, activities, and ASL. There are many ways of getting information that has the potential to expand visual creativity and visual intelligence in a study by Shepherd. Pictures, charts, and graphs can help learners understand better. ASL is a visual or gestural language with no vocal element. ASL uses fingers to make a sign for a word, letter, or number. Facial expressions are also a part of ASL. Table 5 shows the Tools needs of the Grade 7 learners with difficulty in hearing in learning Mathematics.

Table 5. Tools Need

Tools	frequency
pictures	13
charts	13
calculators	5
sign language	1
activities	2
modules	1
examples	6
manuals	1
data	1
high tech tools	1
follow up	1
graphs	3
visual aids	1
graphics	1
animation	1
video clips	1

The assistive technology needs of Grade 7 learners with difficulty hearing AT tools to accomplish tasks in American Sign Language, graphics or visual aids like charts, pictures, graphs, manuals, modules, calculators, high-tech tools like video clips, animation, and examples.

Using the WATI Assessment, the Grade 7 learners with difficulty in hearing have the following needs in Mathematics and Hearing-Communication areas.

Table 6: WATI Results

MATHEMATICS	frequency
Math manipulatives	19
Low-tech physical access	19

HEARING - COMMUNICATION	
Closed Captioning	19
Classroom/ group activities	19

Based on Table 5 and Table 6, Grade 7 learners with difficulty hearing need Math manipulatives and low-tech physical access to Mathematics. Examples are algebra tiles, wooden blocks or squares. For their hearing needs in communication in the classroom, closed captioning and classroom or group activities are necessary.

Consolidating the SETT and WATI results, the assistive technology lesson exemplar developed was the multimedia that used American Sign Language in the videos, closed captioning, videos, math manipulatives and ICT applications during classroom activities.

Table 7. Evaluation of the Lesson Exemplar by Mathematics Experts

Category	Expert 1	Expert 2	Expert 3	Mean	Description
A. Content	4.00	3.43	2.29	3.24	Acceptable
B. Instruction Quality	4.00	3.33	2.67	3.33	Acceptable
C. Presentation and Organization	3.80	3.20	2.40	3.13	Acceptable
D. Assessment	4.00	3.33	2.67	3.33	Acceptable

Table 8. Evaluation of the Lesson Exemplar by Special Education Experts

Category	Expert 1	Expert 2	Expert 3	Mean	Description
A. Content	3.00	3.86	3.71	3.52	Acceptable
B. Instruction Quality	3.67	4.00	4.00	3.89	Acceptable
C. Presentation and Organization	3.60	3.60	3.20	3.47	Acceptable
D. Assessment	4.00	3.67	3.67	3.78	Acceptable
E. Special Accommodation	4.00	3.33	3.67	3.67	Acceptable

Table 9. Evaluation of the Lesson Exemplar by ICT Experts

Category	Expert 1	Expert 2	Expert 3	Mean	Description
A. Content	3.71	3.14	3.29	3.38	Acceptable
B. Instruction Quality	3.00	2.67	3.67	3.11	Acceptable
C. Presentation and Organization	3.60	2.80	2.80	3.07	Acceptable
D. Assessment	3.00	2.67	2.67	2.78	Moderately Acceptable
E. Navigation and User Interface	3.86	2.86	3.57	3.43	Acceptable
F. Technical Requirements	3.33	3.33	4.00	3.55	Acceptable

This result means that the assistive technology lesson exemplar developed was acceptable in all categories for all the experts.

The SPED teachers evaluated the lesson exemplar during the implementation of the lesson exemplar during the class observations. The results are shown in Table 10.

Table 10. Evaluation of SPED Teachers

Category	Lesson 1	Lesson 2	Lesson 3	Lesson 4	Lesson 5	Mean	Level of Acceptability
A. Content	3.79	3.88	3.90	3.94	4.00	3.90	Acceptable
B. Instruction Quality	3.94	4.00	3.85	3.93	4.00	3.94	Acceptable
C. Presentation and Organization	3.80	3.90	3.84	3.92	3.92	3.88	Acceptable
D. Assessment	3.94	4.00	4.00	4.00	4.00	3.99	Acceptable
E. Special Accommodation	4.00	4.00	4.00	4.00	4.00	4.00	Acceptable

7. Results

The following were the results from the gathered data:

1. The level of competencies in Mathematics of Grade 7 learners with difficulty in hearing is below 75%, described as "Did not meet expectations".
2. The least mastered competencies of Grade 7 learners are the following:

For QUARTER 1- Estimated the square root of a whole number to the nearest hundredth., Uses Venn diagrams to represent sets, subsets and set operations. Performs operations on rational numbers., and Represents real-life situations which include real numbers.

For QUARTER 2 - Illustrates linear equation and inequality in one variable. and Solves problems involving conversion of units of measurement.

3. The assistive technology lesson exemplar developed was the multimedia that uses American Sign Language in the videos, closed captioning, videos, math manipulatives, and ICT applications during classroom activities.
4. The three experts in Mathematics, SPED, and ICT validated the lesson exemplar for acceptability. The lesson exemplar is acceptable in all the categories. The SPED teachers evaluated the lesson exemplar based on the Content, Instruction Quality, Presentation and Organization, Assessment and Special Accommodation. The lesson exemplar is acceptable in all categories.

8. Conclusions

Based on the findings of the study, the following conclusions are drawn. The level of competencies in Mathematics of Grade 7 learners with difficulty in hearing did not meet the expectations based on the K to 12 grading system. The level of competencies in Mathematics of Grade 7 learners with difficulty hearing are below their peers in mainstream education. Using the SETT framework and WATI Assistive Technology checklist helped determine the appropriate assistive technology lesson exemplar. The assistive technology lesson exemplar developed was of great help to Grade 7 learners with difficulty in hearing in Mathematics based on the feedback of the SPED teachers and Grade 7 learners with difficulty in hearing.

This technology is an innovation in Special education. Special educators or educators teaching learners with difficulty in hearing are not equipped to use assistive technology in their classes. The learners' needs are not considered like an individualised education plan (IEP). Collaboration with other experts like developmental paediatricians, Ears, Eyes, Nose and Throat Doctors(EENT), occupational therapists (OT), and physical therapists does not exist. It can help the SPED educator or teacher in making the IEP of a learner. A regular hearing test is also recommended. Some teachers are not SPED majors but are graduates of other courses related to their subjects. An open mind is necessary to make innovations possible. The support of the Department of Education Officials, policymakers, curriculum planners, and school administrators in financial support and policies can make this innovation possible.

9. Recommendations

Given the data and findings generated and the conclusions drawn from the data analysis, the following recommendations are suggested now.:

Teachers, SPED educators, and SPED Teachers in schools are aware of the level of competence in Mathematics of the Grade 7 learners with difficulty in hearing. They may consider remedial classes, teaching strategies and tools suited to their learners. Seminars can be done using the IEP, SETT framework and WATI Assessment checklist for special educators. This strategy can help them choose the appropriate learning plan and assistive technology that will cater to their learners, and they may consider using the assistive technology lesson exemplar to make learning easy in their classes.

Parents and learners can make use of the findings of this study to be aware that there are assistive technologies available that can be customised to suit the learner's needs.

Department of Education Officials, policymakers, curriculum planners, and school administrators may introduce curricular innovations and programs.

Textbook writers and researchers may draw insights from the study's findings and the assistive technology lesson exemplar developed to design lesson exemplars that promote inquiry-based learning and use assistive technology for learners with hearing difficulties. Further research and textbooks can be done to bridge the gaps.

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