

## THE STRATEGICAL USE OF CONCEPT MAPS IN READING COMPREHENSION OF STUDENTS WHO ARE DEAF

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**Abstract.** The aim of this paper is to examine the effectiveness of semi-completed concept map instruction in reading comprehension of students who are deaf. An intervention study based on ABA research design took place, which involved scaffolding instruction on the use of concept maps in the reading comprehension of narrative texts. A 10-year-old deaf student born to deaf parents participated in our study. The effectiveness of concept map instruction in reading comprehension was evaluated based on the student's responses to seven multiple choice reading comprehension questions and text recalls in Cypriot Sign Language. The instruction on concept maps improved the student's reading performance, as indicated mostly in text recalls.

### 1 Introduction

Reading comprehension is a challenging task for students who are deaf, which is partly attributed to their prior language and background experiences before entering school (Andrews & Mason, 1991; Perfetti & Sandak, 2000). Based on schema theory, children rely on their prior knowledge, which is stored in memory in the form of abstract cognitive structures called schemata, to construct the meaning of a text (Schirmer, 2000). Deaf students are often brought up within an environment where they have a limited access to language, reading and world experiences (Andrews & Mason, 1991). Therefore, they develop poor schemata that affect negatively their ability to derive the meaning of a text (Schirmer, 2000; Stewart & Kluwin, 2001), especially in intermediate or higher grades when texts become scripturally implicit and their understanding requires more background information (Gardill & Jitendra, 1999). For deaf children born to deaf parents, the situation is different, because they have access to communication and acquire a sign language (Marschark, 1993; Musselman, 2000), but at school they are required to learn to read in a second language (Perfetti & Sandak, 2002), a highly challenging task, especially considering that the transition from a signing to the written form of an unknown spoken language is a more complicated procedure compared with the transition from a spoken to the written form of the same spoken language (Goldin-Meadow & Mayberry, 2001; Marschark & Harris, 1996).

Consequently, students who are deaf or hard of hearing have diverse language needs and encounter various difficulties in reading comprehension, such as understanding vocabulary and syntax, and applying metacognitive reading strategies (Andrews & Mason, 1991; Kelly, 2003; Paul, 1998; Strassman, 1997). Therefore, teachers are required to plan and implement instruction that respond effectively to their reading needs. This is an aim hard to accomplish, considering that despite years of research it has not been identified which practices are effective to promote learning and specifically reading comprehension in students who are deaf (Spencer & Marschark, 2010). Among the practices that can enhance reading comprehension in deaf students, are visual strategies, considering that deaf students have a limited auditory access but a total visual access to information (Easterbrooks & Baker, 2002; Luckner, Bowen, & Carter, 2001). The aim of this paper is to examine the role of graphical tools or graphical strategies, namely concept maps, in reading comprehension of students who are deaf and hard of hearing.

Concept maps are graphical tools for organizing and representing knowledge. They are used to categorize information into a graphic form, create a visual representation of the concepts within the text, the relationships among them and the text structure (Sturm & Rankin-Erickson, 2002). They include concepts enclosed in boxes and relationships between concepts through the use of connecting lines and words linking two concepts (Novak & Cañas, 2006). Graphical tools convert a linear isomorphic text into a nonlinear graphic presentation, which makes the macrostructure of the text more salient. Their spatial properties help readers identify, compare and retain information or draw inferences about relations, supporting, in this way, cognitive processing that do not overload students' working memory. The content within a text becomes conceptually transparent and therefore it becomes easier for the readers, especially the ones with poor language and reading skills, to understand, retain and retrieve it (Chang, Sun & Chen, 2002; Novak, 1991; Novak & Cañas, 2006; O' Donell, Dansereau & Hall; Vekiri, 2002).

All the above characteristics of graphical tools can play a positive role in reading comprehension for deaf students, who due to their poor schemata experience various difficulties in processing a text, understanding the syntax, the concepts and the structure of the text. However, very few research evidence exists regarding the role

of concepts maps and in general graphical tools, in deaf students' reading comprehension. Castillo, Mosquera and Palacios (2008) explored the effectiveness of concept maps to foster reading comprehension skills in a 13-year-old deaf student. They compared the comprehension of a text with comprehension of its transcription to a concept map format, both with and without illustrations. According to the results, the concept map format improved the student's understanding of the text and also motivated the students' interest more so than the text format. Furthermore, Nikolarazi and Vekiri (2012) examined the perceptions of teachers regarding deaf students' behavior while reading digital narrative texts along with three visual resources Greek Sign Language videos, concept maps and pictures, presented within a software entitled "*See and See*". Based on teachers' comments, all students were motivated to read the texts but they used the visual resources depending on their prior experience. In particular, they rarely used the concept maps because they had no prior knowledge regarding concept maps and they were not instructed on how to use them in reading comprehension. The researchers concluded that instruction on visual literacy strategies is required for students to learn to use concept maps effectively.

Considering the limited research, this study aims to further explore the role of concept maps in deaf students' reading comprehension. Specifically, the aim of this study was to examine the effectiveness of concept map instruction in a deaf student's reading comprehension of narrative texts. Previous research with hearing students (see O'Donnell, Dansereau & Hall, 2002) as well as the study with deaf students by Nikolarazi and Vekiri (2012) indicated that students' training regarding graphical displays affect the way that they use them. In this study a single-case study took place, based on ABA research design, which involved concept map instruction. The following research questions were stated in our study: 1) What was the effectiveness of the concept map instruction in reading comprehension of narrative texts as indicated through reading comprehension questions, and 2) What was the effectiveness of concept map instruction in reading comprehension of narrative texts as this was indicated through text recall.

## **2 Methodology**

### *2.1 The participant*

In this study one participant was involved, Maria, a 10-year-old student with profound hearing loss, who was born to deaf parents, communicated in Cypriot Sign Language (CSL) and attended a special school for the deaf. We selected a single participant, because she was born to deaf parents and she was proficient in a sign language, specifically CSL, allowing the instruction to take place which required a high level of language skills. Deaf children born to hearing parents rarely have such language skills in a sign language, because in contrast with deaf children born to deaf parents, they do not have full access to communication since their birth, as explained at the beginning of our paper. Another reason for selecting one student concerns the fact that Cyprus has a small population of approximately 800.000 and deaf children with deaf parents constitute a very small minority among deaf students considering that 90% of deaf students are born to hearing parents (Moore, 1996). Maria attended the 4<sup>th</sup> grade and her reading performance based on teachers' reports was in the 2<sup>nd</sup> grade. Also, we assessed her reading comprehension performance through reading texts and replying to reading comprehension questions and recalling texts and we found out that she was very poor in recalling tasks. A test that examined her short-term memory took place before the intervention took place, which indicated that Maria was capable of recalling a high number of information that was presented visually to her.

### *2.2 Materials*

In our study, we used 21 reading narrative texts which were selected according to Maria's reading level. For each text a semi-completed concept map was designed. Specifically, each concept map contained some boxes including part of the main elements of the narrative text (e.g. characters, the setting) and some empty boxes which concern the rest of the information of the narrative text (e.g. plot resolution). In order to fill in the missing information within the concept map, the student had to identify the relevant information within the text. Following, an example is provided of a text titled "The painter" and the accompanied semi-completed concept map.

#### "The painter"

During the past few weeks Flora's mom has been asking her husband to paint the little house in the backyard. Her husband, Mr. Costas is constantly postponing the task. But today he is holding a bowl of paint and a brush in his hands.

He opens the bowl, he puts the brush in and he starts working.

“What an awful work to do”, he says.

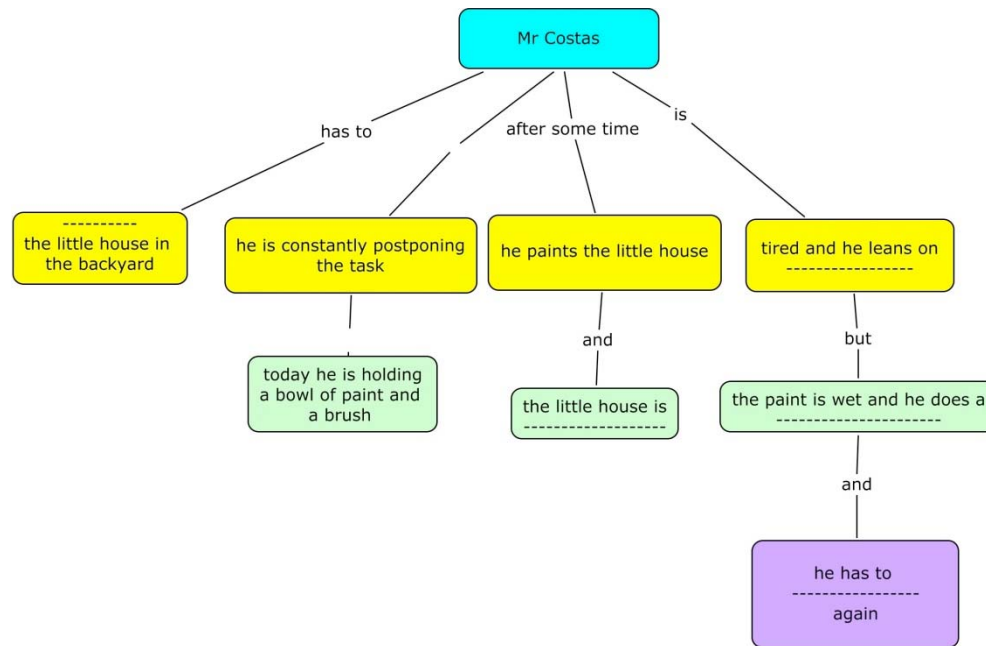
He puts his brush in the bowl. Why does he hate painting so much? After some time he finishes painting the little house.

“Finally”

He puts the brush down and looks at it. The little house seems nice. Mr. Costas is very tired and he has a backache. He leans on the little house. He soon realizes what he has done. He just leaned on the wet paint. He jumps right up. There is a big stain where he leaned.

“Oh no! Now I have to do the painting all over again”

Poor Mr. Costa!



For each text, the researchers developed seven reading comprehension multiple choice questions, including five textually explicit questions, to which the answers were explicitly mentioned in the passage, and two textually implicit questions which require the reader to combine various points of the text to reply to them. It is important to note that most of the questions addressed the important information of the text, which were also presented within the concept map.

### 2.3 Research design and Procedure

A single subject research A-B-A design was followed in the study. *In phase A*, the researchers collected baseline data regarding Maria’s performance for six consecutive days. Specifically, each day the student was asked to read one narrative text along with an incomplete concept map and a set of seven reading comprehension multiple choice questions. After reading the text, the student was asked to read the concept map, fill in the empty boxes and then answer the reading comprehension questions. When this task was completed the participant was requested to recall the text in CSL. The student was videotaped during her text recall.

*In phase B*, the intervention was implemented for nine consecutive days. At the beginning of this phase the scaffolding instruction took place, during which the researcher guided the student how to read and use the incomplete concept map. Instruction included the following steps: 1) The researcher read part of the text and then asked the student to read the rest of the text, 2) the researcher read the concept map from top to bottom and from the left to the right and then asked the student to read part of it, 3) the researcher read again the concept map in the following way: each time she encountered a completed box she read the information within the box and then returned to the text to identify the information in the text. Similarly when the researcher encountered an empty box she went back to the text and searched the text to identify the missing information and fill in the box. The researcher went back to the text and forth to the concept map several times until she identified the missing information in the text and completed the relevant part in the concept map. Next, the researcher guided the student to follow the same steps, 4) when the researcher and the student completed the concept map they replied to the reading comprehension questions, which addressed the important points that could be identified in the text and the concept map. The researcher instructed the student how to reply to the questions. Specifically, the

researcher read each question and all the available answers, then she went back to the text and the concept map and searched for information that could help her answering the questions. Each time the researcher identified the relevant information for the question in the concept map she pointed out this information to the student and then proceeded to answer the question. The researcher went back to the text and forth to the questions several times in order to find the relevant information to each question. Next, she guided the student to do the same, 5) after replying to all questions the researcher read once again the concept map and also guided the student to do the same, 6) at the end she recalled the text in CSL and also encouraged the student to do the same. During the first days the researcher demonstrated and guided the student's learning by following the above steps, while gradually the researcher's guidance was being removed.

In the final post-intervention *Phase A*, Maria was asked to read six narrative texts for six consecutive days, fill in the semi-completed concept maps, reply to the reading comprehension questions and recall the text in CSL. The guided instruction was completely withdrawn.

#### 2.4 Analysis

Our data analysis was based on the student's performance in multiple choice questions and in text recall in CSL, which were videotaped and then transcribed by two researchers who were fluent in CSL. Following, we analysed student's recalls using pausal units. A pausal unit stands for the phrase break which occurs when a reader briefly stops reading in order to take a breath. All texts were broken down to pausal units with the use of slash marks (/), after three fluent hearing adults read the texts to the researchers who noted the pausal units designated by the readers. The final number of pausal units was agreed by at least two of the three readers. These pausal units formed the basis upon which we calculate the scores of recalling of our student. Specifically, the student's recalls were analysed based on two measurements. The first measurement regarded the quantity of recalled pausal units that is the number of the text's pausal units that the student recalled. The second measurement was the weighted quantity of recalled pausal units, that is the level of closeness of each recalled pausal unit to the original pausal unit of the text (Andrews, Winograd & Deville, 1994). Following, an example of the analysis is provided, based on a section of the text titled "The painter":

##### Text:

*English:* During the past few weeks Flora's mom has been asking her husband/ to paint the little house in the backyard./ Her husband, Mr Costas is constantly postponing the task./ But today he is holding a ball of paint and a brush in his hands

*Greek:* Εδώ και βδομάδες η μαμά της Φλώρας ζητάει από το μπαμπά της μικρήσ/ να μογιατίσει το σπιτάκι του κήπου./ Ο κύριος Κώστας το αναβάλλει συνέχεια./ Μα σήμερα κρατάει την μογιά και τη βούρτσα του στα χέρια του./

##### Text Recall:

*English:* Mom is asking constantly Costas her dad,/ to paint the house and he is postponing it./ Now Costas decided to paint/ and he is holding the paint and the brush.

*Greek:* Η μαμά ζητάει συνέχεια από το Κώστα τον μπαμπά/ να μογιατίσει το σπίτι και αυτός συνέχεια το αναβάλλει./ Τώρα ο Κώστας αποφάσισε να βάψει/ και κρατάει μογιά και βούρτσα./

##### Analysis:

Pausal units in the original text abstract: 4

Recalled pausal units for this abstract: 4

Level of closeness of the four recalled pausal unit to the original pausal units in the text: 14 (87.5%)

| <b>Pausal units in the text (4)</b>                               | <b>Recalled pausal units (4)</b>                                      | <b>Level of closeness (Total 14)</b> |
|---|---|--------------------------------------|
| During the past few weeks Flora's mom has been asking her husband | Mom is asking constantly Costas her dad                               | 3                                    |
| to paint the little house in the backyard                         | to paint the house it   | 3                                    |
| Her husband, Mr Costas is constantly postponing the task          | and he is postponing  | 4                                    |
| But today he is holding a bo of paint and a brush in his hands.   | Now Costas decided to paint and he is holding the paint and the brush | 4                                    |

### 3 Results

#### 3.1 Multiple choice reading comprehension questions

The student's responses to the multiple choice questions of the 21 narrative texts indicated that performance in Phases B and A was similar. Specifically, the average percentage of right answers achieved by the student for the six narrative texts during the Baseline Phase A was 95%, whilst in the intervention Phase B a slight increase of right answers is noted, achieving a percentage of 100%. During the Maintenance Phase A, the percentage of right answers remained steady at 100% (see Figure 1).

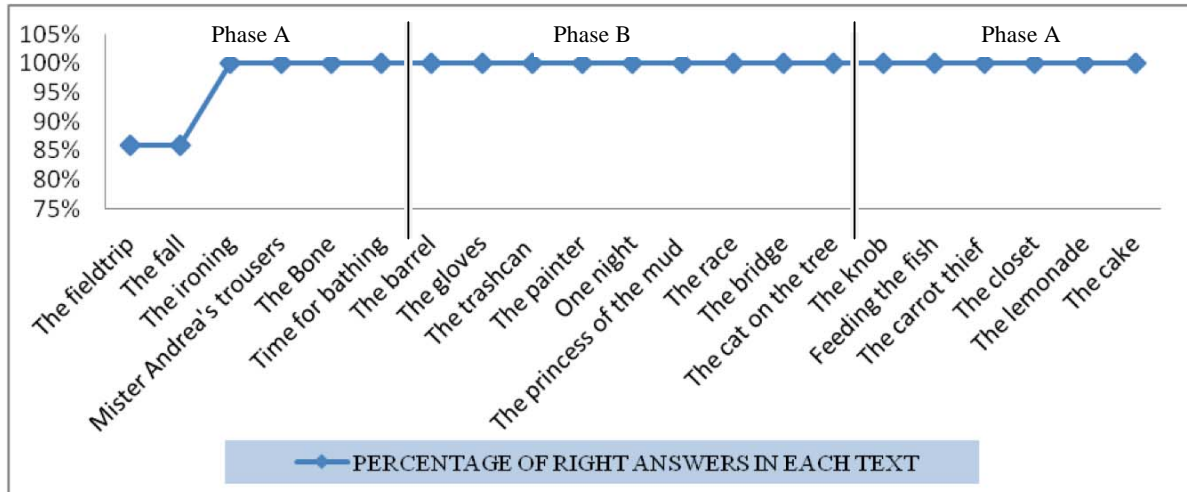


Figure 1. Percentage of right answers in each text

The similarities regarding the student's performance between Phases A, B and A are indicative of the minor effect of the intervention, as the student was able to answer correctly almost all multiple choice questions for the 21 narrative texts used in all Phases. A slight increase from Phase A to Phase B was only evidenced.

#### 3.2 Text recall

The analysis of the text recalls, based on the quantity and the quality of recalled information, is summarized in Figures 2 and 3. Regarding the first measurement, that is the quantity of the recalled pausal units, an upward trend was identified. In Baseline Phase A, the average quantity of pausal units that the student recalled was 22% of the total number of pausal units in the original text. In Intervention Phase B, that the concept map instruction took place, the average quantity of the recalled pausal units increased to 36%. In the Maintenance Phase A, the average quantity of the recalled pausal units reached 46%, illustrating that the effect of the intervention remained (Figure 3).

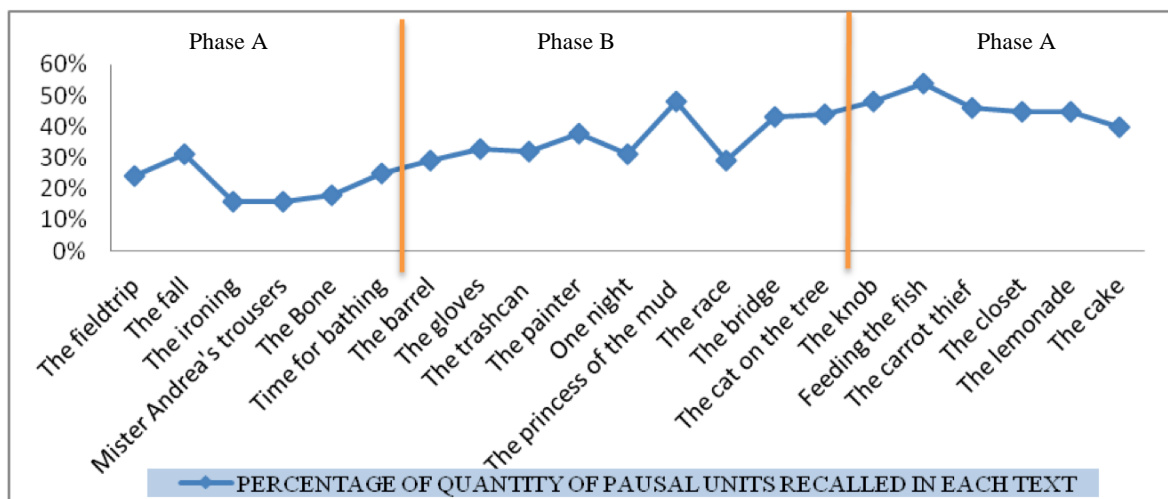


Figure 2. Percentage of quantity of the recalled pausal units in each text

Student's performance regarding the second measurement of weighted quantity of the recalled pausal units is noticed to have changed also. In Baseline Phase A, the average percentage of weighted quantity of recalled pausal units was 72% comparing with the meaning of the original pausal units of the texts. In Intervention Phase B, the student's performance improved as the average percentage of weighted quantity of the recalled pausal units increased to 84%. In the final Phase A, the average percentage of weighted quantity of the recalled pausal units remained high at similar levels as in phase B reaching 88%.

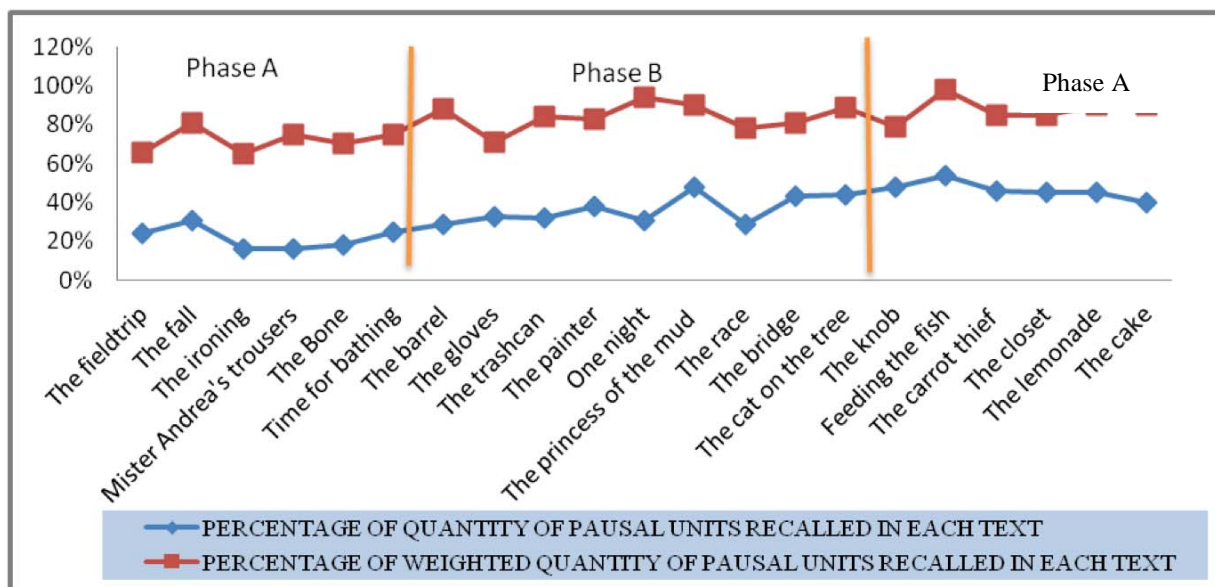


Figure 3. Percentage of quantity and weighted quantity of the pausal units recalled in each text

Figure 4 summarizes the results from all measurements obtained from the student's responses in reading comprehension questions and the text recalls based on the quantity and the quality of the recalled pausal units in all Phases. It is evident that the student's performance in general was improved during Phase B that the intervention took place and this improvement remained in the final Phase A. This improvement was particularly evident in text recall.

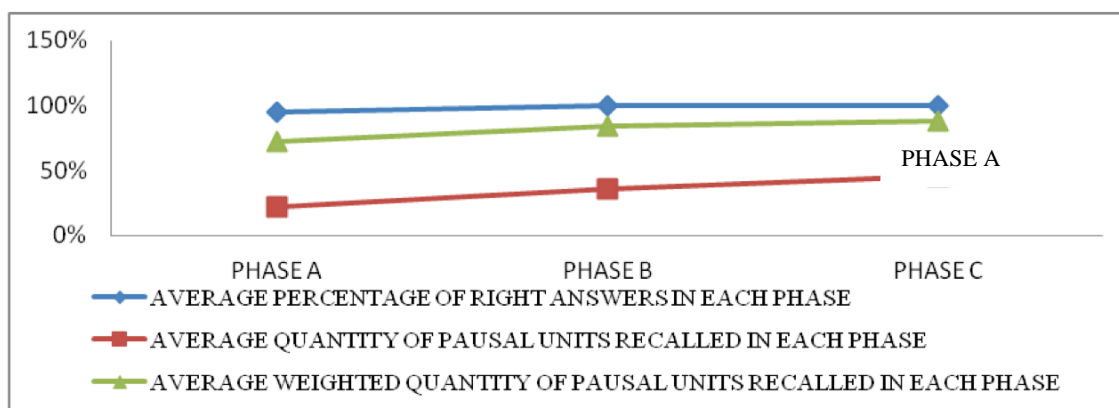


Figure 4. Average scores of student performance in reading comprehension questions and text recall

#### 4 Discussion

According to the results of this study, the concept map improved the student's performance as this was indicated through text recall, while no improvement was observed in reading comprehension questions, where she had a good performance from the beginning. Possibly, Maria's prior knowledge with completed concept maps aided her reading comprehension as this was indicated through her responses in reading comprehension questions. Prior research (Chmielewski & Dansereau, 1998) has indicated that prior knowledge and training regarding graphical tools affect students' ability to use them effectively.

However, although Maria has prior knowledge with concept maps, her performance in text recall from the beginning was lower compared with her performance in the questions and an improvement in text recall was observed during the intervention phase. Possibly, through instruction in completing semi-completed concept maps rather than using ready-made concept maps, Maria was encouraged to get more cognitively engaged in understanding the concept map and the text which helped her also to retain more information. Also, during the instruction the student was instructed on how to use the concept map in a strategic way, because she was guided and encouraged to read multiple times the concept map and different parts of the text and relate the information within the concept map and the text. This instruction probably helped Maria to recall the text in a more effective way as this was indicated though both measurements, the quantity and the weighted quantity of the recalled pausal units.

Our study indicates that the effective use of concept maps in reading comprehension by students who are deaf or hard of hearing requires the systematic instruction on the strategic use of the concept map. By making students aware of the value of visual aids and instructing them on how to use them strategically, readers who are deaf or hard of hearing as well as other students with or without special educational needs can benefit from visual information and learn to exploit visual aids effectively in order to enhance their reading comprehension performance (Nikolarazi & Vekiri, 2012)

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