International Journal of Pedagogy and Teacher Education

Journal Homepage: jurnal.uns.ac.id/ijpte

Teaching Individuals with Down Syndrome and Moderate or Severe Intellectual Disability with the Aim of Their Acquiring, Retaining and Recalling Knowledge: An Intervention Programme for Discovering and Understanding the Environment

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ARTICLE INFO

Article History

Received: Aug 19th , 2021

1st Revision: Sep 8th , 2021

Accepted: Sep 15th , 2021

Available Online: Oct 4th , 2021

Keywords:

down syndrome
environmental education
intervention
learning
retention knowledge- recalling from memory

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ABSTRACT

Three adults with Down syndrome (DS, hereafter) and moderate or severe intellectual disability were taught the growth stages of wheat (cultivation, tillage, threshing), the products that are derived from it and how this staple human food grain is produced, with the aim of their acquiring knowledge, retaining it and being able to recall it from memory. A quasi-experimental baseline design was implemented. The participants were taught using questions and images, and their answers were examined and re-examined after withdrawing the initial training tools (questions and images) in order to show whether they were able to acquire, retain and recall the knowledge. The intervention programme lasted two months. In order to check the effectiveness of the intervention and the maintenance of the new information, as well as to draw the respective conclusions, evaluations were carried out before the intervention, immediately after it and two weeks after its completion. The results showed that the three participants acquired knowledge about the growth stages of wheat, its products and this staple human food, they retained that knowledge and were able to recall and narrate it in two subsequent probes conducted one and two weeks after the initial probe without the help of questions and images. The results of this intervention show that individuals with DS and moderate or severe intellectual disability can be educated and acquire knowledge, as well as retain and recall it. An additional important finding is that repeated recalling of knowledge promotes long-term retention.

How to cite: Lappa, C. S., & Mantzikos, C. N. (2021). Teaching Individuals with Down Syndrome and Moderate or Severe Intellectual Disability with The Aim of Their Acquiring, Retaining and Recalling Knowledge: An Intervention Programme for Discovering and Understanding the Environment. *International Journal of Pedagogy and Teacher Education*, *5*(2), 66-81. https://dx.doi.org/10.20961/ijpte.v5i2.54526

1. INTRODUCTION

LEARNING AND KNOWLEDGE

Learning is studied by scientists primarily in the domains of pedagogy and psychology. It is a process that contributes to permanently altering people's behaviour within a short period of time (Flouris, 1995). People perceive this transformation in terms of their ability to perform certain acts that they were previously unable to perform.

Human learning can be divided into three categories: a) learning related to the acquisition of information and cognitive skills that are required for dealing with various problems in everyday life, b) learning related to the individual's emotions, experiences, attitudes, values and beliefs, and c) learning related to movements and motor skills (Kassotakis & Flouris, 2013).

Nowadays, education refers to the learning and acquisition of knowledge and abilities in a wide range of subjects, which is usually accomplished through the use of a symbolic language system (spoken and written). The phenomenon of learning and acquiring knowledge is the process of acquiring, retaining and utilising information (Estes, 1975, as cited in Porpodas, 2003).

However, the terms 'information' and 'knowledge' are not synonymous. The inputs that an individual receives from their environment through their sensory organs are referred to as information. These sensations are remembered and can be recalled by the individual. In a nutshell, information is the main cognitive substance from which knowledge is generated. The process of learning, processing and assimilating information through an individual's cognitive processes, as well as the correlations between them, results in knowledge (Novak, 1998).

p-ISSN: 2597-7792 / e-ISSN: 2549-8525
DOI: https://dx.doi.org/10.20961/ijpte.v5i2.54526

According to Neisser (2014), knowledge involves the processes through which inputs are converted, processed, stored, retrieved and utilised. As a result, knowledge appears to include all human mental activity (Kell, 2018).

In order for information to be processed and knowledge to be acquired, the information that the individual receives at any one time must be coded, maintained for a period of time, compared to the information already in memory, utilised and/or forgotten (Porpodas, 2003). The association of data with visual cues enhances coding, enabling the data to be stored more effectively in memory and eventually retrieved more quickly (Kassotakis & Flouris, 2013). Furthermore, repetition has a catalytic effect on the retention of knowledge in memory and the ease with which it can be retrieved (Reynolds & Glasser, 1964, as cited in Kassotakis & Flouris, 2013).

A lower-level teaching goal is to learn information and simple knowledge in a primarily declarative style. The development of cognitive skills, on the other hand, is a higher-level teaching goal. For the acquisition, retention and application of knowledge, specific cognitive functions/skills are activated. These are mental behaviours or processes aimed at acquiring information and gaining understanding through the use of cognition, experience and the senses (Davis, Pitchford, & Limback, 2011), and they include: perception, as the first stage of information processing; memory, which concerns the ability to retain and retrieve information; language, which is the means of obtaining and transmitting information; thinking, which relates to correlating information and drawing conclusions; and finally, the ability to solve problems (Porpodas, 2003).

As a result, knowledge and cognitive skills should not be conflated. This misunderstanding has been highlighted in the worldwide academic literature that arises due to the association of cognitive skills with knowledge (Almlund, Kardash, & Kulhavy 1986; Borghans, Golsteyn, Heckman, & Humphries, 2016; Duckworth & Yeager, 2015; Heckman, Humphries, & Kautz, 2014; West et al., 2016).

DOWN SYNDROME

DS is the most common genetic disorder that causes intellectual impairment (Anderson et al., 2013; Constestabile, Benefenat, & Gasparini, 2010; Daunhauer et al., 2014). Infants with DS are the most well-studied population with intellectual disability (Macchini, Leva, Torricelli, & Valade, 2011), and the syndrome occurs in around 1 in 800 births (Stasinos, 2013). DS is caused by trisomy (having three copies instead of the usual two) of all or part of chromosome 21. Trisomy of the whole chromosome occurs in 95% of cases (Sommer & Henrique-Silva, 2008).

DS can potentially be caused by one of two additional factors. The first is permutation, in which a part of chromosome 21 binds to another chromosome, and the second is mosaicism, in which there are two cell lines, one normal and the other with trisomy 21 (Roberts, Price, & Malkin, 2007).

Individuals with DS have varying degrees of intellectual disability, ranging from severe to limited mental function (Constestabile et al., 2010), with the majority demonstrating moderate to severe intellectual disability (Lott & Dierssen, 2010).

DOWN SYNDROME AND LEARNING

DS children have inadequate academic (school) abilities (Stasinos, 2013). These individuals avoid new and difficult activities due to cognitive impairments (Fidler, 2006). Yussof (2010, as cited in Yussof, Wan Mohd Anuuar, Rias, Abas, & Ariffin, 2016) mentions various stages of the learning process for children with DS. Sight, hearing, touch, taste and smell are the five basic sense organs that children use to receive information. This type of data is termed sensory information. They then categorise and analyse sensory data through the process of perception, and perception is subsequently stored in their memory. Finally, individuals recall information or knowledge from memory and apply it to a new situation. It is critical that children with DS put what they have learnt into practice so that they can learn new skills. As a result, they must reclaim and reuse knowledge (Mara & Mara, 2011).

Children with DS have been found to have deficiencies in both expressiveness (Maltesse, Pepi, Scifo, & Roccella, 2014; Martin, Losh, Estigarribia, Sideris, & Roberts, 2013; Polišenská & Kapalková, 2014; Zampini, Salvi, & D'Odorico, 2015) and grammar. This means that the language skills of many children with DS do not progress past the early stages of morphology and syntax development, which poses a significant barrier to learning (Fidler, Hepburn, & Rogers, 2006). This is why the majority of individuals with DS have moderate learning disabilities (Chapman & Hesketh, 2000) and some have severe learning disabilities, while others have moderate mental ability (Roizen, 2002). Despite this, research suggests that a considerable percentage of children and adolescents

p-ISSN: 2597-7792 / e-ISSN: 2549-8525
DOI: https://dx.doi.org/10.20961/ijpte.v5i2.54526

with DS achieve and learn some degree of literacy skills, although the degree to which this is achieved varies widely (Kay-Raining Bird, Cleave, & McConnell, 2000).

As a result, children with DS are able to learn. However, in comparison to children of typical development and children with equivalent mental potential, the rate of learning and the variety of abilities that can be acquired differ. Contrary to popular belief, according to research, cognitive development in people with DS continues throughout adolescence and beyond. Young adulthood has also been proposed as the optimal period for a person with DS to focus on literacy development (Moni & Jobling, 2001). As a result, people with DS learn differently throughout their lives. More specifically, their performance improves when they receive feedback (Baroody, 1996), are supported by parents who participate in the educational process (Nye, Fluck, & Buckley, 2001), choose individualised teaching (Bashash, Outhred, & Bochner, 2003) or when visual information is provided (Abbeduto et al., 2001; Lappa, Kyparissos, & Paraskevopoulos, 2011).

To date, no modern teaching tools have been discovered that are appropriate for use by children with DS as part of their learning process (Yussof et al., 2016). As a result, strategies such as project analysis, routine practice and learning motivation, which have been explored in the past, can help to address the lack of sensory processing, when it exists, and provide the child with many opportunities to generalise learning concepts and behaviours (Iacob & Musuroi, 2013). When the teacher's instructions are clear and understandable, the behaviour that must be demonstrated during the course of learning becomes clearer (Salvaras, 2013). Good approaches include play, systematic instruction, repetition of concepts and abilities, automation (Mara & Mara, 2011) and the use of visuals (de la Iglesia, Buceta, & Campos, 2005). Visual support (images, picture books, silent movies) aids in the development and improvement of narrative skills in adolescents with DS (Miles & Chapman, 2002). They also learn by observing the activities of others (Reed, Staytom, Stott, & Truzoli, 2011) and when they are rewarded for their actions (Kogan et al., 2009). Finally, the use of multimedia helps children with DS to develop cognitive processes that facilitate symbolic thinking (Agheana & Duță, 2015).

DOWN SYNDROME AND MEMORY

Memory refers to the brain's ability to store and retrieve new knowledge acquired via a variety of experiences. It is an important part of the learning process. Short-term memory, working memory, long-term memory (Verucci, Menghini, & Vicari, 2006) and episodic memory (Edgin et al., 2010; Edgin, Spano, Kawa, & Nadel, 2014; Roberts & Richmond, 2018) are all areas in which people with DS struggle. However, it appears that conservation has a greater impact on the coding and recall processes in people with DS (Milojevich & Lukowski, 2016).

In particular, deficits are identified mainly in the verbal/auditory working memory (Patterson, Rapsey, & Glue, 2013) and delayed recall is observed (Fidler & Nadel, 2007). Several recent studies examining working memory in individuals with DS have identified potential deficits in verbal working memory, whereas audiovisual memory is usually relatively intact (Costa, Purser, & Passolunghi, 2015). Therefore, Hodapp and Freeman (2003) reported that individuals with DS respond when working memory activities are presented visually rather than verbally. However, some studies have shown relative potential in audiovisual processing (Fidler, 2005).

Several researchers have argued that the general difficulties in verbal communication experienced by people with DS may explain their poor working memory performance (Vianello, 2006). In other words, difficulties with verbal working memory may be related to the general difficulty that people with DS experience in undertaking tasks that require verbal processing, as a result of the syndrome's overall low language skills. Of course, the inverse might also occur. That is, deficits in verbal working memory may affect and even cause (at least in part) a lack of verbal skills.

Individuals with DS also struggle with episodic memory tasks such as learning and memorising words from lists, visual patterns and visual-spatial associations (Edgin et al., 2010; Edgin et al., 2014). Individuals with DS exhibit special impairments in recalling and associating individual details of an experience, according to research by Banta Lavenex et al. (2015) and Courbois et al. (2013). These weaknesses are critical to their survival because they prevent them from making decisions in new contexts for which they are unprepared.

Several studies have looked into techniques to help people with DS improve their memory. Symbols/characters, as well as visual memory skills, can be used as a compensatory method in vocabulary acquisition. Kay-Raining Bird, Gaskell, Babineau, and MacDonald (2000), for example, compared new word acquisition in children with DS in three conditions: written words only, spoken words only, and written and spoken words combined. The premise that the combined mode enhances word learning was confirmed by higher

p-ISSN: 2597-7792 / e-ISSN: 2549-8525
DOI: https://dx.doi.org/10.20961/ijpte.v5i2.54526

scores in test conditions. Adolescents with DS perform well when there is visual accompaniment (a book without words, images, or a film without words) during storytelling (Boudreau & Chapman, 2000; Miles & Chapman, 2002). However, they recall less information when stories are told without visual aids (Kay-Raining Bird, Chapman, & Schwartz, 2004).

It is a fact that education helps people with DS enhance their memory skills (Bennett, Holmes, & Buckley, 2013; Costa et al., 2015; Lanfranchi, Pulina, Carretti, & Mammarella, 2017; Pulina, Carretti, Lanfranchi, & Mammarella, 2015), which is why memory training is so vital. Training in strategies that can enhance memory is also crucial, because retrieving current information is more beneficial for learning than re-studying it (Starling, Moreira, & Jaeger, 2019). One of the essential demands of people with DS is to exercise memory through repetition or the use of strategy (Minan-Espigares, 1999, as cited in de la Iglesia et al., 2005).

THE PURPOSE AND IMPORTANCE OF THE STUDY

The goal of this study was to determine, through an intervention programme, whether individuals with DS and moderate to severe intellectual disability can learn about the stages of wheat development, how it is grown, the work that farmers do from ploughing to threshing, the products that are derived from it, how bread (as a staple food) is made, and whether it is possible to preserve and retrieve information when visual and verbal assistance is withdrawn. The study was conducted after a review of the international literature revealed that few studies have addressed the issue of how individuals with DS obtain new information, how information is retained and retrieved, and the mechanism by which this is accomplished. The study findings will help to fill this gap.

It was decided to teach an environmental issue to people with DS and intellectual disability in the hope that it would increase the students' environmental awareness, their willingness to participate in environmental activities and their ability to develop environmental awareness. Environmental education has been shown to benefit children with disabilities and/or special educational needs in terms of their cognitive, emotional and social development (Lappa, Kyparissos, & Paraskevopoulos, 2016; Lappa, Mantzikos, & Paraskevopoulos, 2019; Minotou, Mniestris, Pantis, & Paraskevopoulos, 2011). Furthermore, cultivating relationships and interacting with the environment is a goal that features in the curriculum (APS) for individuals with severe intellectual disability (Greek Ministry of Education, 2004).

As a result, the research questions for this study were:

(1) Can individuals with DS who have moderate to severe intellectual disability learn new material in a subject with which they are unfamiliar through spoken questions and visual assistance (images)?

(2) Can individuals with DS who have moderate to severe intellectual disability retain and retrieve information learnt through the intervention without needing visual and verbal aids after a short period of time?

2. RESEARCH METHOD

PARTICIPANTS

Three adults aged 27 to 45 years with DS and intellectual disability from a residential facility in the Thessaly region of Greece participated in this study. Each participant has limited expressive language and there is no Greek-standardised test of expressive language ability available that we could use; thus, we could only indirectly evaluate their linguistic ability via the Verbal Scales of the Wechsler Intelligence Scales (WISC-III). The participants were evaluated on their mental capacity before the intervention using the Wechsler Intelligence Scales for Children (WISC-III).

Table 1. The age and mental score of each adult

Names	Age	Diagnosis	WISC-III
Antonis	27	DS/Severe Intellectual Disability	34
Ioulia	37	DS/Severe Intellectual Disability	35
Barbara	45	DS/Moderate Intellectual Disability	53

ETHICAL CONSIDERATIONS

The first author requested the permission of the director/president of the residential facility to conduct this study. Furthermore, the names of the participants have been changed to conceal their identities.

FUNCTIONAL DEFINITIONS

p-ISSN: 2597-7792 / e-ISSN: 2549-8525
DOI: https://dx.doi.org/10.20961/ijpte.v5i2.54526

Responses were defined as:

• Contextual answers without help: when the participant answered correctly immediately after the question, and the researcher did not provide help.

• Contextual answers with help: when the participant did not answer correctly or found it difficult to answer immediately after the question, and the researcher provided help.

• Noncontextual answers: when the participant answered incorrectly.

Data were collected during the following conditions: baseline, training (four sessions), one initial probe/evaluation and two subsequent probes/re-evaluations.

PROCEDURE

Each training session was held in a quiet room with three seats and a table for the participants to sit around. A video camera was set up on a tripod in one corner of the room. The educational material pertaining to the wheat cycle, which consisted of 12 images, one behind the other, was on the table. Each image represented a question and its answer.

The participants entered the room and sat around the table. The camera began to record and the researcher gave the prompt 'Let's learn the life cycle of wheat'. Sessions during the training stage were approximately 15 minutes in duration. During the training, the researcher asked a question about an image and provided a model answer. Each question was answered by all of the participants. The researcher asked each participant the 12 questions individually at the end of the session. When all of the questions about the wheat cycle had been answered, the session came to a close. The data were collected over a two-month period.

EXPERIMENTAL SESSIONS

In an applied behaviour analysis programme, the researcher must clearly specify the behaviours to be observed so that they can be observed, assessed and agreed upon by those evaluating the programme's performance and execution. The baseline condition refers to the rate at which the researcher evaluates the desired behaviour prior to training. In other words, the measurement of the dependent variable before the start of the intervention is saved in the database. The most important goal of this type of programme is to alter behaviour. Behaviour during the subsequent probe should be compared with the behaviour in the baseline condition (Kazdin, 2011).

In the three baseline conditions, there were twelve grain-related photos available, numbered one after the other. The participants were informed that they would be taught about the 'wheat cycle'. No preparation was undertaken for viewing the material. At this point, no aid or supportive effect was provided regarding the desired behaviour. The first researcher showed the image, asked the question and waited for the answer. The intervention began when it became apparent that the participants' performance was constantly zero.

During the group training/direct teaching (four sessions), the first researcher gave each participant a picture in turn and posed the question associated with the respective image, as well as providing a model of each answer. The image aided the participant in comprehending the question and learning the response that he or she was required to provide. As a result, there were no comprehension issues with the content of the questions and answers in this study. Prompt feedback was given in the case of an incorrect answer and reinforcement offered when a correct answer was supplied. Direct teaching was favoured because it is clear, systematic and well-structured, and it offers students a support system that helps them improve their cognitive function (Golley, 2015). Of course, in the context of the behavioural approach, most educators and psychologists talk about direct instruction through reward and feedback processes (Koutou, Makri, Touloumi, Tsamasfyra, & Frantzi, n.d.).

Table 2. The questions and answers that the participants were taught to answer

	Questions	Answers
1	What do you think you notice in the picture?	Wheat seeds.
2	Where should wheat seeds be planted?	In the field.
3	What is the purpose of watering the field?	For the wheat to grow.
4	What colour is the wheat when it first sprouts and when it matures?	It starts out green and gradually changes to a golden-yellow tint.
5	What do farmers do when the wheat becomes golden-yellow?	They harvest it.
6	What do farmers do with wheat when it is harvested?	They take it to the mill to grind it.

p-ISSN: 2597-7792 / e-ISSN: 2549-8525
DOI: https://dx.doi.org/10.20961/ijpte.v5i2.54526

7	What shape does the wheat take after milling?	It becomes flour.
8	What are we going to do with the flour?	We use it to make bread, communion bread, biscuits and other baked goods.
9	Where are we going to bake the bread?	In the bakery's oven.
10	After that, what can we do with the bread?	We can sell it to customers.
11	What can we do, if we make communion bread?	We can take it to church.
12	What is the priest's role in regards to the communion bread?	He gives it to us during Holy Communion.

During the training, the first researcher asked each participant personally about the wheat cycle at the end of each session. The other participants waited their turn outside the room. The order of the twelve questions was always the same. When a participant had trouble answering, the first researcher stepped in to assist by providing immediate feedback and the correct answer.

Following the training, the ***initial probe (evaluation)*** was conducted. The first researcher presented the images and asked the questions throughout the assessment; however, at this time, the researcher did not offer any help to the participants. The goal was to see if the participants had acquired the new information.

After a week, ***subsequent probe 1 (re-evaluation)*** was conducted, in which only the questions were asked. The goal was to see if the participants remembered the information and could answer the questions without glancing at the images.

One week later, in ***subsequent probe 2 (re-evaluation)***, the participants were asked to present the wheat cycle without being asked any questions and without seeing the images. The participants were once again tested to see if they could remember the information and recall the 'cycle' of wheat from memory without being asked questions or seeing the images.

The participants were verbally praised for their correct answers during the training. A cookie was given to each participant as a reward for good participation during all the conditions of the intervention (baseline, training, initial probe/evaluation, and subsequent probes/re-evaluations). During the probes, no verbal patterns, corrections or vocal praise were provided.

EXPERIMENTAL DESIGN

A within-subject quasi-experimental design across the conditions of baseline, training, initial probe/evaluation and subsequent probes/re-evaluations through three subjects was used to demonstrate the acquisition and retention of new information. This was a variation of an experimental design based on estimating and subtracting intervention elements after demonstrating a change in behaviour. It comprised a sequential-withdrawal design of the various components of the initial intervention, in order to evaluate the results when all of the initial components had been removed.

According to Rusch and Kazdin (1981), design variants have been proposed that assess the gradual removal of interventions in the maintenance of behaviour/knowledge. Plans are referred to as withdrawal plans because the intervention is removed in various ways to maintain the execution of the behaviour/knowledge. Withdrawal plans are used to assess whether acquired behaviours/knowledge are maintained under different conditions. As a result, elements of the removal/withdrawal plans can be added to other plans. After a clear demonstration of the results of the intervention, withdrawal procedures can be added to assess behavioural/knowledge retention (Kazdin, 2011).

This type of experimental design is a single subject design that aims to show the acquisition of new information and its preservation after the gradual withdrawal of the training components. Tests/evaluations are used to determine if performance – the target – has changed during the survey. Because the contingencies applied in education do not apply to subsequent probes/re-evaluations but are gradually removed/withdrawn, the data from these evaluations evaluate the retention and retrieval of information through new situations (Kazdin, 2011).

INDEPENDENT AND DEPENDENT VARIABLES

The independent variables in the present study were the verbal example of the researcher, the corrections, pictures, verbal praise and the final reward for good participation (reinforcement system). The dependent variable was the number of answers (contextual answers without help, contextual answers with help, noncontextual answers) from each participant per session. Any answers (words, phrases or sentences) that were

p-ISSN: 2597-7792 / e-ISSN: 2549-8525
DOI: https://dx.doi.org/10.20961/ijpte.v5i2.54526

audibly comprehended were calculated as answers. The data were collected and ranked separately for each participant.

INTER-OBSERVER AGREEMENT (IOA)

All of the sessions were video-recorded and scored by two researchers (the experimenter and an observer). The agreement score was calculated point by point. The number of agreements was divided by the total number of agreements and disagreements and multiplied by 100 to give a percentage. All sessions were rated, and the average agreement rate was 90%.

3. RESULT AND ANALYSIS

The intervention data are presented per participant. The X-axis shows the consecutive sessions and the Y-axis shows the number of answers for each participant. The vertical lines represent changes in conditions in the order of baseline, training, initial probe and subsequent probes.

A black circle represents a contextual answer with help. A white circle represents a contextual answer without help. A black triangle represents a noncontextual answer.

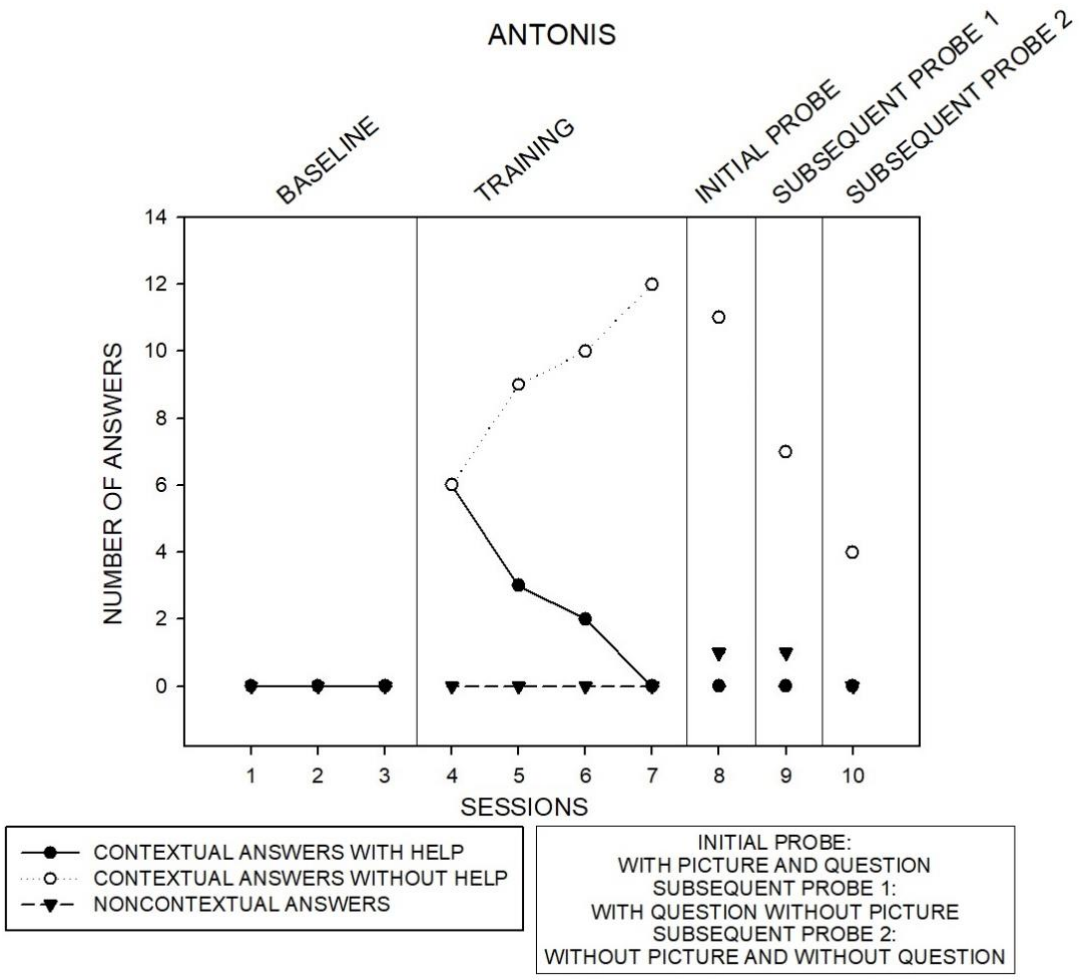

Fig 1. The number of answers per session from Antonis

Figure 1 presents Antonis' answers. Antonis did not provide any answers during the three baselines. During the training, he provided contextual answers with help. These declined in number towards the end of the training as more contextual answers without help (12) were provided, a situation which Antonis maintained during the initial probe/evaluation (11). The first subsequent probe/re-evaluation was conducted one week later, in which

p-ISSN: 2597-7792 / e-ISSN: 2549-8525
DOI: https://dx.doi.org/10.20961/ijpte.v5i2.54526

the images were removed. Antonis gave 7 contextual answers without help. The second subsequent probe/re-evaluation was held in another week's time, and the researcher did not pose the questions in this session. Antonis gave 4 contextual answers about the wheat cycle from memory without help.

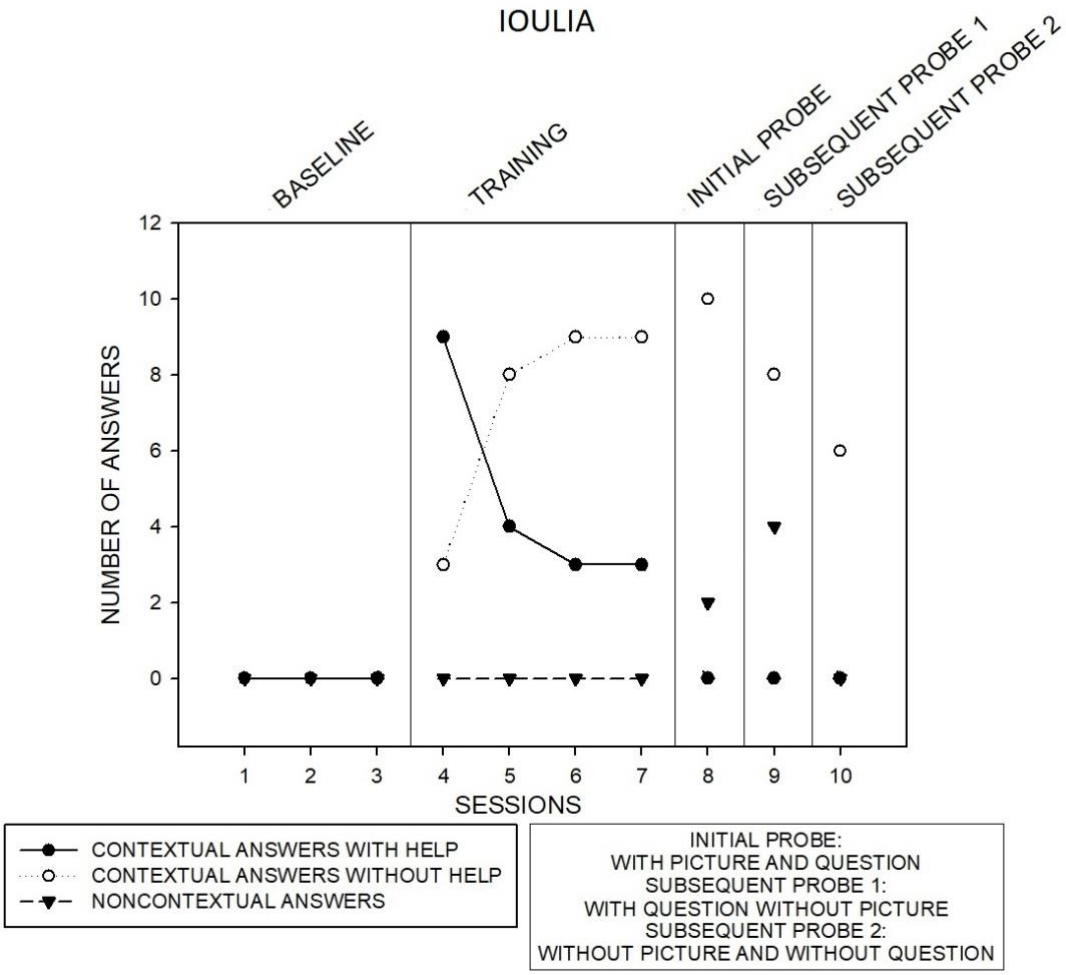

Fig 2. The number of answers per session from Ioulia

Figure 2 presents Ioulia's answers. During the three baselines, Ioulia did not give any answers. In the first training, she provided relevant contextual answers with help, but these declined in number over the subsequent sessions as she provided more contextual answers without help (9). In the initial probe/evaluation, Ioulia answered 10 out of 12 questions without help. In the first subsequent probe/re-evaluation, in which the images were not available, Ioulia answered 8 questions correctly without help. In the second subsequent probe/re-evaluation, she correctly gave 6 of the 12 answers from memory.

p-ISSN: 2597-7792 / e-ISSN: 2549-8525
DOI: https://dx.doi.org/10.20961/ijpte.v5i2.54526

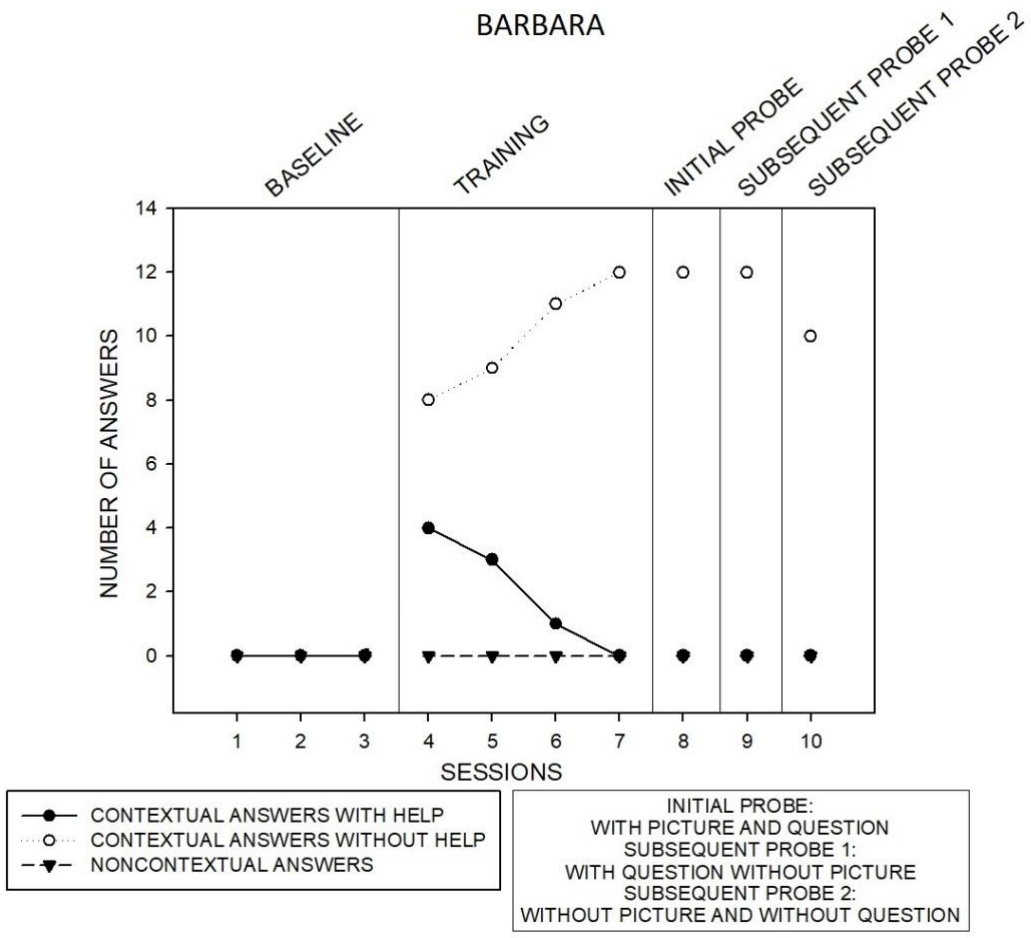

Fig 3. The number of answers per session from Barbara

Figure 3 presents Barbara's answers. Barbara gave no answers during the three baselines. In the first training, she gave 4 contextual answers with help and 8 correct answers without help. In the following training sessions, she provided an increasing number of contextual answers without help, up to the maximum possible (12). In the initial probe/evaluation, Barbara gave all the answers correctly without help (12). This was repeated for the first subsequent probe/re-evaluation, where no images were presented. In the second subsequent probe/re-evaluation, she gave 10 correct answers from memory without help.

SOCIAL VALIDITY MEASURES

In general, social validity refers to an examination of the social criteria for the purpose of evaluating the intervention, the procedures used and the impact they had on the performance of the research participants. Social validity can be measured in one of two ways: social comparison or subjective appraisal. Target performance is evaluated as a means of validating the results of the intervention through subjective evaluation. Specialist individuals capable of making a judgement assess the target performance that has changed as a result of the intervention. The evaluation is performed to provide an overall assessment of the participants' performance in the research after the intervention. The person asked to judge the participants' performance should be able to determine whether there has been a considerable change in performance against the goal (Kazdin, 2011).

Therefore, a group of teachers was asked to evaluate the intervention to determine the reliability of the results and the validity of the method. The group consisted of five special education teachers who responded to the call. They observed an initial training session (baseline or first session) and a final training session (initial

p-ISSN: 2597-7792 / e-ISSN: 2549-8525
DOI: https://dx.doi.org/10.20961/ijpte.v5i2.54526

probe/evaluation or subsequent probe/re-evaluation). They did not know which training session came first and which came afterwards, and they could not guess. The instructions were to attend two training sessions of the intervention in random order and to assess a) in which situation (before or after the training) the participants performed better, and b) the level of improvement, by completing a short questionnaire. The general conclusion, as assessed by the team of teachers, was that the participants showed moderate to high performance.

4. DISCUSSION

The goal of this study was to see if it was possible for individuals with DS who have moderate or severe intellectual disability to learn more about the stages of development of wheat, the work required by farmers from ploughing to threshing, the products produced, how a basic human staple food (bread) is prepared, and its utility, through an intervention programme and whether or not the information could be saved and retrieved even after visual and verbal aids had been removed.

A review of the literature identified various effective teaching practices that assist individuals with DS in learning new information and cognitive skills. Examples include play, structured teaching, practice through repetition of concepts and skills, automation (Mara & Mara, 2011) and the use of images (de la Iglesia et al., 2005). Simple and understandable instructions from the teacher clarify the behaviour that must be demonstrated throughout the course of learning (Salvaras, 2013). As a result, it is understandable that when adults with DS have opportunities and use appropriate learning strategies, they can acquire information and develop and improve their cognitive and language skills (Moni & Jobling, 2001).

In this study, all three adults with DS who had moderate to severe intellectual disability were able to learn new information about the 'cycle' of wheat, indirectly improve their language skills, retain the new information for at least two weeks and recall it under different conditions, such as the removal of the image and query.

As a result, it was discovered that through an environmental intervention, the participants were able to recognise information, which is a prerequisite for learning, retain and retrieve the information that had been received, and use language effectively, which is the primary means by which people learn and acquire knowledge (Porpodas, 2003).

The 'wheat cycle' was selected as a parallel goal for these individuals' environmental education, the aim of which is to foster environmental awareness and positive participation in environmental actions. Through the environmental study programme, the participants were able to learn about wheat, its stages of development and the products that are derived from it. People with DS thus learn in a more specific way (Mara & Mara, 2011). The participants' poor performance in the baseline condition was most likely due to a lack of subject knowledge. However, during the training, all three participants provided an increasing number of contextual answers without help related to the 'wheat cycle' at the same time as giving fewer contextual answers with help, thus demonstrating that they can learn new things through intervention. According to the literature (Cologon, 2013; Monari Martinez & Pellegrini, 2010; Yussof et al., 2016), individuals with DS can be trained in various cognitive subjects if they receive the appropriate intervention. In this study, the use of visual material/images and questions aided in the acquisition of new information. Simultaneously, the researcher's direct teaching and systematic feedback provided during the training stage aided in the achievement of the goal. Vygotsky (1978) argued that learning occurs more effectively when there is assistance from another person, such as a kind adult. As a result, the research findings are consistent with the international literature, which contends that the use of good practices and strategies results in the successful education of individuals with DS.

While children with DS have difficulties in working memory for verbal information, which makes processing verbal information and, as a result, learning by listening particularly difficult, the use of visual information benefits these individuals because visual-spatial working memory outperforms verbal memory (Kavaliotis, 2010; Levy & Eilam, 2013). Individuals with DS can remember and comprehend new information better when it is presented in the form of images (Rosemas Edayu, 2007, as cited in Yussof & Paris, 2011). Images have been shown to assist individuals with DS in retrieving more of the information that has been received visually compared to verbally (Miles & Chapman, 2002). This finding can (and should) be used to help those with the least processing power (Hughes, 2006). In this study, the use of images during the training helped the participants understand the questions more easily because each image corresponded to a question, and thus they acquired the new information faster. At the same time, it aided each participant in comprehending the nature of the questions. The use of visual material in the education of people with DS is critical because it utilises their strong visual memory and improves their retention of verbal information and understanding (Lecas, Mazaud, Reibel, &

p-ISSN: 2597-7792 / e-ISSN: 2549-8525
DOI: https://dx.doi.org/10.20961/ijpte.v5i2.54526

Rey, 2010). As a result, intervention programmes for children with DS must incorporate the visual pathway because it enables faster learning while maintenance is similar to the auditory pathway (Gupta & Shetty, 1992). The use of visual stimuli and verbal instructions produces even better results (Kay-Raining Bird, Gaskell, et al., 2000), as demonstrated by this study. Simultaneously, it has been demonstrated that improving working memory functioning has a positive impact on speech, language and cognitive development in children and adults with DS (Hughes, 2006).

Furthermore, it is worth noting that during the repeated probes/evaluations, the participants retained the new information despite the removal of the original components used during the training (images and questions). And, although the literature frequently refers to memory difficulties in individuals with DS, the participants were able to recall all or part of the material taught during the repeated probes/evaluations (one and two weeks after the initial probe/evaluation). The ability to recall information from memory is commonly regarded as the most fundamental method of assessing information learning and knowledge acquisition (Porpodas, 2003). It should be noted that even if a participant is unable to recall all of the information (and narrate it), this does not necessarily imply that he has not learnt the specific information; however, it does indicate that the learning of this information has not been completely effective, and thus retrieving it becomes difficult. It is also worth mentioning that the participants were able to narrate the entire 'wheat cycle' or a portion of it without visual stimulation or asking questions. This is a very important finding because it contradicts the international literature that claims that adolescents with DS perform satisfactorily in narrative skills only when there is visual stimulation (book without words, pictures, film without words) (Miles & Chapman, 2002).

According to Amerikanou, Masoura, Papageorgiou, and Moraitou (2017), repeated information retrieval promotes long-term retention not immediately after a probe/evaluation, but a week later. During a probe or evaluation, it appears that the information stored in long-term memory becomes active and is subject to further processing and re-storage (Roediger III & Butler, 2011, as cited in Amerikanou et al., 2017). Repeating this process even once results in long-lasting, enhanced mnemonic traces that resist wear and tear over time (Amerikanou et al., 2017). According to the international literature, repeated examination/evaluation as a learning method during training (Leeming, 2002, as cited in Amerikanou et al., 2017) leads to better and longer retention of the material taught (Agarwal, Finley, Rose, & Roediger III, 2017; Amerikanou et al., 2017; Leggett, Burt, & Carrol, 2019; Lyle & Crawford, 2011; McDaniel, Agarwal, Huesler, McDermott, & Roediger III, 2011); this is also supported by the findings of this study.

Although recall practice is beneficial for long-term learning, only a few studies have been conducted to date to determine whether it can be a beneficial learning strategy for people with varying cognitive and developmental characteristics (Starling et al., 2019). This issue, namely the recall of memory in people with DS, was also investigated in the studies of Milojevich and Lukowski (2016) and Roberts and Richmond (2015). In the field of special education, it has been demonstrated that repeated recall does not lead to more learning but rather to more resilient learning in the long run (Amerikanou et al., 2017). At the same time, knowledge is being generalised in new environments (Lappa et al., 2011; Lappa, Fr. Anastasiou, Mantzikos, & Kyparissos, 2018). As a result, it is worth investigating whether this method of learning can benefit all people with disabilities and/or special educational needs.

LIMITATIONS AND FUTURE DIRECTIONS

The current study has several limitations that should be mentioned. Firstly, only three people with DS and intellectual disability took part in the study. As a result, the sample size prohibits the findings from being generalised to the larger population of people with DS and intellectual disability. The findings are only applicable to individuals who share the same characteristics and properties as the sample.

At the same time, no control group was used in the current study, with either individuals with DS or individuals without disability. This is because the goal was not to compare two groups but to see if people with DS and intellectual disability can acquire new information, retain it and retrieve it based on their abilities and special education methods. Future studies may use a more representative sample and investigate additional factors (such as gender, intellectual age/intelligence quotient, previous 'experience', and environment) to ensure more representative results.

Because the goal of the study was simply to show the participants' performance before and after the intervention and under different conditions, such as the withdrawal of visual and verbal aids, no comparative study was conducted between performance in the baseline and initial probe or between performance in the

p-ISSN: 2597-7792 / e-ISSN: 2549-8525
DOI: https://dx.doi.org/10.20961/ijpte.v5i2.54526

baseline and subsequent probes. Future research may focus on this topic.

Meanwhile, other limitations were discovered at the level of the bibliography search for the purpose of writing this research article. Extensive searches of large databases and major publishers revealed no extensive literature on adults with DS learning, retaining and retrieving new information, thereby proving that this is the first study in Greece to examine how adults with DS learn, retain and retrieve new information.

5. CONCLUSION

Individuals with DS and intellectual disability can learn new information about a subject if the teaching is structured (use of visual and/or verbal stimuli, direct teaching, systematic teacher feedback), leading to the retention of information over time and the recall of information from memory when needed.

The findings of this study are significant for both early intervention and the education of people with DS in general. A thorough understanding of how these people learn will almost certainly lead to the development of programmes that will enhance their abilities while also compensating for their weaknesses.

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p-ISSN: 2597-7792 / e-ISSN: 2549-8525
DOI: https://dx.doi.org/10.20961/ijpte.v5i2.54526