



Special Needs Teachers' Perceptions on the Educational Digital Game the "Four Forces"

Kleio Mourelatou

ORCID: 0000-0002-9603-2327 • ResearcherID: V-8214-2017

Milen Zamfirov

ORCID: 0000-0003-2231-015X • ResearcherID: V-8511-2017

Sofia University "St. Kliment Ohridski"
Faculty of Preschool and Primary School Education

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Abstract

It is a well known fact that there is a discrete group of pupils with severe problems in the acquisition of mathematical skills. These problems go beyond a quantitative range, but differ qualitatively from the ways the pupils gain mathematical knowledge from their teachers in the classroom. The central thesis of this survey is the development of the educational digital game the "Four Forces", and the teachers' perceptions concerning whether the specific digital game reduce mathematic and memory difficulties in students with intellectual disabilities. This was achieved by comparing and contrasting the teachers' perceptions on this particular issue through questionnaires via e-mail. Through the survey findings it has been observed that special needs teachers have similar perceptions about the digital math games, which they agree that they could enhance students' cultivation of memory capacity and could improve the development of numerical skills.

Keywords: Intellectual disabilities, mathematical difficulties, memory difficulties, digital game, teachers' perceptions.

1. Introduction

The central thesis of this survey is the development, implementation and evaluation of an educational digital game for reducing mathematic and memory difficulties in students with mental disabilities, compared to the traditional learning in school. The survey aims to give insight within a short time, into visible improvement of students' image in the field of mathematical awareness and the development of numerical skills.

As it is known, on the basis of the development of individual skills in different areas of learning, it is always the development of one or more skills in cognitive development. The development of numerical skills, and generally the development of learning skills in mathematics seem to be directly related to the mnemonic capacity of the student and various distinctive functions (Christakis, 2006). Two threads of research are examined: the cultivation of memory capacity and the development of arithmetic skills.

- Teachers’ perceptions on memory and learning.
- Teachers’ perceptions on memory and Mathematics.
- Teachers’ perceptions on learning difficulties in Mathematics.
- The effect of the digital game the “Four Forces” both in the mnemonic capacity and arithmetic performance.

Proceeding from the study’s purposes, the survey will obtain the following objectives:

- the construction and implementation of an educational digital game for the systematic teaching and development of arithmetic skills and mnemonic capacity of students with moderate mental disabilities under the guidance of the curriculum students with disabilities.
- the study of the effect of the program and the evaluation of the results both in the mnemonic capacity and arithmetic performance.
- the study of the psychosocial dimensions of students with moderate mental disabilities.
- the useful conclusions in order to conduct future similar surveys in the context of school.

2. Methodology

2.1.1 *Research approach*

A deductive approach was used to undertake this research. Initially, the literature was used to identify theories and ideas and proceeded to a more specific conclusion by using data. Saunders et al. (2003), point out that the deductive approach gives priority to: scientific principles, moving from theory to data, the collection of quantitative data, the application of controls to ensure validity of data, a highly structured approach, and necessity to select samples of sufficient size in order to generalise conclusions.

2.1.2 *Research strategy*

A survey strategy was deemed the most appropriate research tool, as Saunders et al. (2003), suggest this strategy is the most suitable when taking the deductive approach. Surveys can be obtained using questionnaires and the data is standardised enabling correlations. Furthermore, surveys, are easily understood because they indicate, for example, a certain percentage of teachers’ perceptions. Questionnaires are one of the data collection methods that belong to the survey strategy (Saunders et al., 2003).

2.1.3 *Collecting primary data using questionnaires*

Firstly, the primary data was collected by using questionnaires. All of the questionnaires were sent via e-mail to special need teachers. Questionnaires are one of the most popular methods of conducting scholarly research (Rose & Grosvenor, 2001). According to Rose and Grosvenor (2001), they carry with them an aura of scientific respectability. Because they use numbers and can present findings in the form of graphs and tables, they convey a sense of solid, objective research. Furthermore, questionnaires are easy to analyse, and most statistical analysis software can easily process them. Written questionnaires become even more cost effective as the number of research questions increases. Gugg and Petre (2007) have pointed out that questionnaires are also familiar to most people. Nearly everyone has had some experience completing questionnaires, and they generally do not make people apprehensive. When

respondents receive a questionnaire in the mail, they are free to complete it in their own time (Denscombe, 2003).

Conversely, Pickard (2007) argues that questionnaires are simply not suited for some people. Often, potential respondents are unwilling to fill in written questionnaires because they are poorly prepared and/or written. Furthermore, when returned questionnaires arrive in the post, it is natural to assume that the respondent is the same person you sent the questionnaire to. A number of researchers have reported that this may not actually be the case (Cohen et al., 2007). In a summary of five studies sponsored by the British Government, Scott (1961) reports that up to ten percent of the returned questionnaires had been completed by someone other than the intended person. For a variety of reasons, the respondent may not be who you think it is. It is a confounding error inherent in questionnaires.

In order to conduct the research, the questionnaires were administered on line, via e-mail, in order to be more cost effective. Moreover, the most widely used scale, which was devised by Likert was used. The Likert scale is made up of a number of positive and negative statements relating to the attitude being measured and the respondents are asked to indicate, using a numerical scale, the extent to which they agree or disagree with each statement.

As suggested by Saunders et al. (2003), maintenance was given also to the design of questions, the clear layout of the questionnaire form, explanation of the purpose of the questionnaire, and pilot testing, since all these factors contribute to bigger response rates, validity and reliability.

First of all, the questionnaire was designed in such a way that data collected could be measurable. Moreover, as suggested by Bourque and Clark (1994), apart from the researcher's own questions, ones used in other questionnaires were adopted and adapted in order to replicate and compare the findings with other studies. The questionnaire was prepared with careful consideration for the respondents, in order to ensure a high response rate. Careful attention was paid to the order and flow of the questions so that were in a logical order for the respondents. Furthermore, it was assured that the questionnaire was easy to read and the responses were easy to fill in. Additionally, a cover letter was included in order to explain the purpose of the survey and encourage teachers to respond.

2.1.4 Collecting secondary data

Subsequently, secondary data was collected. Secondary data is data that has already been collected and collated by somebody, for some reason, other than the current study. It can be used to get a new perspective on the current study, to supplement or compare the work or to use parts of it (Saunders et al., 2003).

The secondary data include three main types of data: documentary, survey and those from multiple sources. They include journals, academic's surveys and books. Secondary data help researchers for statistical measures, for instance, the educational beliefs derived from teachers. Furthermore, it helps to triangulate findings derived from primary data collected through questionnaires. Finally, the main advantage of using secondary data is that it saves both time and money.

2.1.5 Selecting samples

Sampling techniques involve selecting individual units to measure from a larger population, providing readers with a clear understanding of the applicability of the study to their

particular situation and their understanding of the same population. This suggests that sampling saves researchers' time and reduces cost (Roberts, 2004).

There are two main types of sampling techniques: probability sampling and non-probability sampling. Denscombe (2003) argues that, probability sampling is a sampling technique wherein the samples are gathered in a process that gives all the individuals in the population equal chances of being selected.

Concerning the size of the sample, Saunders et al. (2003), state that when there is a sample of at least 30 responses, the level of certainty reaches, normally, 95%. The margin of error characterises the accuracy of the estimates of the society.

2.1.6 Response rate

Sufficient response rates are important for surveys. The percentage of people who respond to surveys is considered the response rate. A high survey response rate helps to ensure that the survey results are representative of the survey population (Rugg and Marian, 2007). The following equation is used to calculate the response rate for a survey:

$$\text{Response Rate} = \text{Number of Complete Surveys} / \text{Number of Participants Contacted}$$

In questionnaire surveys undertaken in North American universities the response rates ranged from 50 to 65% (Willimack et al., 2002).

2.1.7 The technique for collecting the sample

A purposive sampling technique was used in order to collect data, using questionnaires, which allow judgement to be used in the selection of cases that will best enable the research question to be answered and to meet the outlined goals. Based on Willimack et al. (2002), who note that a usual response rate ranges from between 50 and 65%, 140 e-mail questionnaires were sent to teachers in order to ensure a minimum response rate of 70. Furthermore, it should be mentioned that the population is homogeneous (special need teachers). The participants were chosen because they have particular features or characteristics which, therefore, will enable the detailed exploration of the research objectives.

2.2 Data results

2.2.1 Analysing quantitative data

The data were prepared with quantitative analysis in mind, in order to use different charting and statistical techniques. Data were entered for computer analysis, in which each column represents a variable and each row a case. Coding data helps researchers to save time, to test their findings in a better way and finally to make comparisons with other surveys (Denscombe, 2003). Quantitative data according to Saunders et al. (2003) are the following: (1) represented and summarised in numerical form; (2) collection results in numerical and standardised data; and (3) analysis conducted through statistical methods.

Data were divided into eight categories, in order to be more accurately measured. These categories concern the "Demographics" of the participants and the teachers' perceptions concerning "Memory and Learning", "Memory and Attention", "Memory and Mathematics", "Metacognition-Metamemory", "Learning difficulties in Mathematics" and their perceptions concerning "The Digital Game". The last category aims to find out teachers' different perceptions on the digital game the "Four Forces".

Initially, the relationships and differences were examined by comparing variables. Both tables and diagrams were used in order to explore the data. More specifically, tables were used to show specific values, bar charts and multiple bar charts to show highest and lowest values. Pie charts and percentage component bar charts were also used to show proportions. Consequent analysis will involve describing the data and exploring relationships. Through the adoption of the Excel Microsoft software, this task will be less time consuming.

2.2.2 Findings

As Saunders et al. (2003) argue, the theory, depends, apart from the design of the research, on the reliability and validity of the research findings and conclusions.

3. Results

3.1.1 Response rate

From a sample of 140 cases (questionnaires sent to special need teachers as explained in the methodology – “sampling technique”), 70 responses were received, a total response rate of 50 per cent (70/140). This response rate meets Willimack’s et al. (2002) research findings, who found that for survey questionnaires in North American Universities, the response rates range from 50 to 65 per cent.

3.1.2 Demographics

So far, 70 special need teachers take part in the survey by completing the questionnaires. 44 of them were women (63%) and 26 were men (37%). Most of the participants were aged 35-44 (54%). Furthermore, most of them (64%) had a Master in Special Education or School Psychology, while only 10 participants (14%) had a PhD in Special Education or School Psychology. 39 of the participants (56%) currently work in the Special Vocational Education and Training Laboratories. Finally, 8 special need teachers report that they have up to 4 years (11%) of service, 56 of them work from 5-10 years (80%), 6 of them work from 10-15 years (9%), and no one has 16 or more years of service.

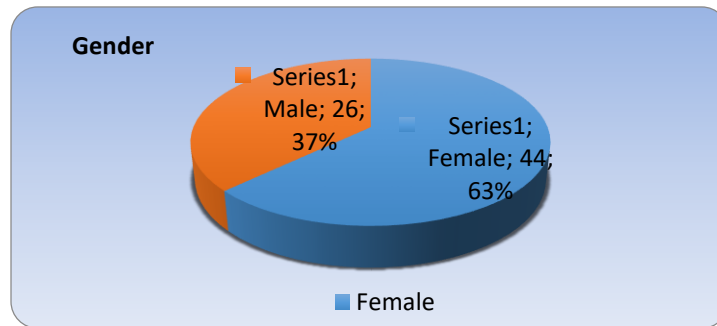


Figure 3.1. Gender of the participants

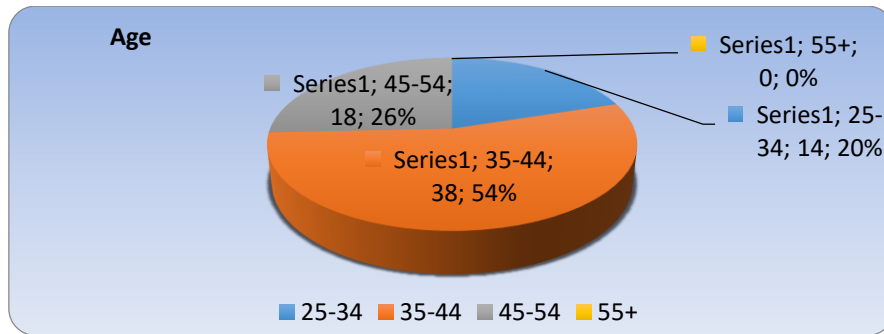


Figure 3.2. Age of the participants

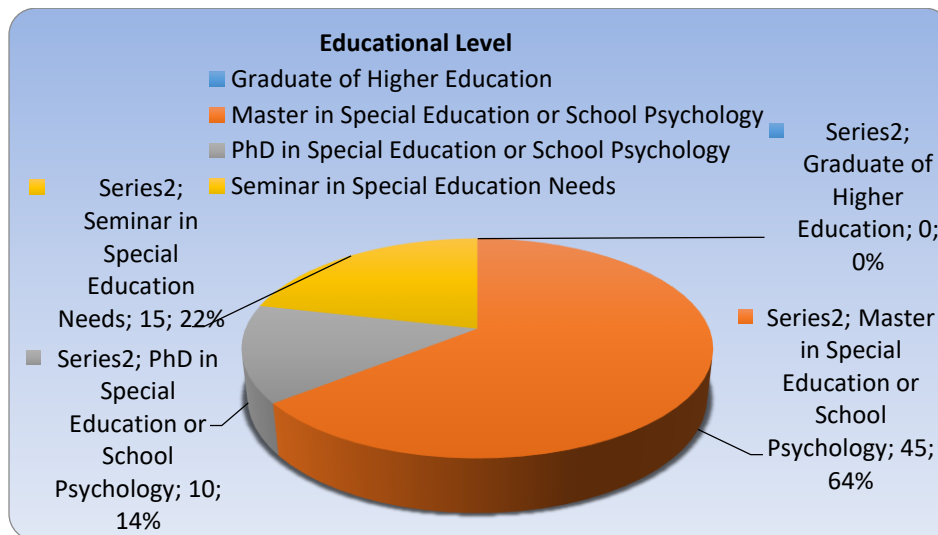


Figure 3.3. Educational level of the participants

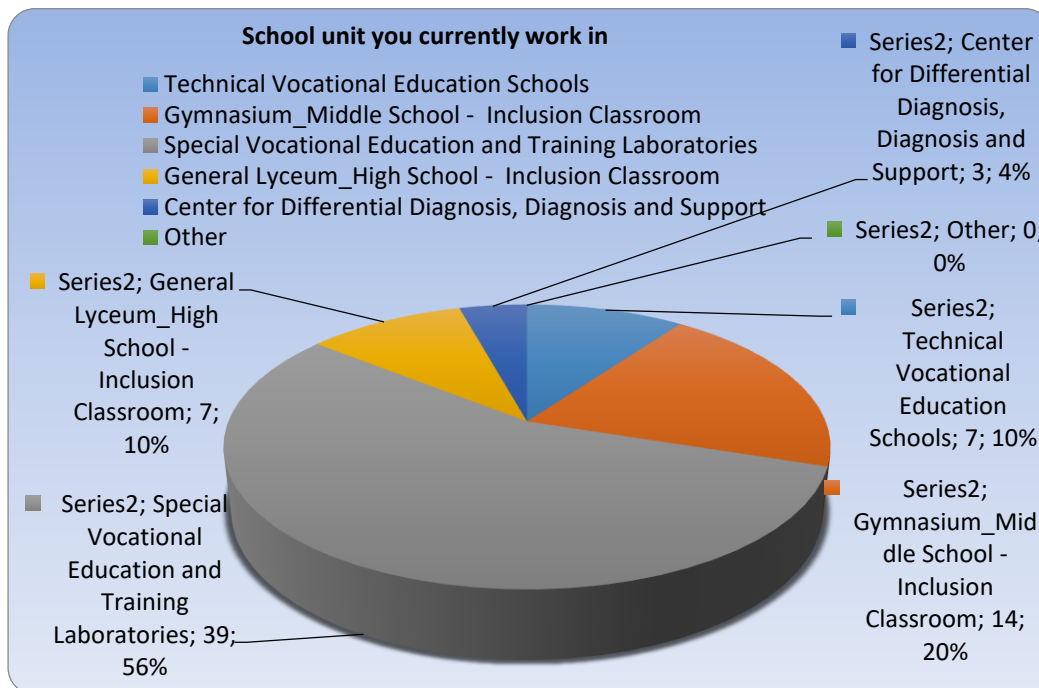


Figure 3.4. School unit the participants currently work in

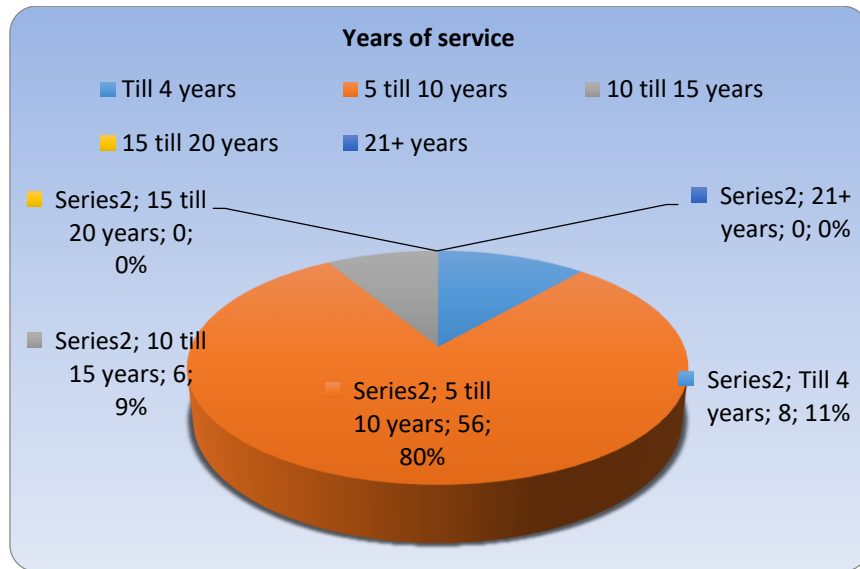


Figure 3.5. Years of service of the participants

3.1.3 Memory and learning

From the literature, it was found that memory is one of the five core functions of the human mind. Furthermore, it is known that the mnemonic capacity, as other capacities of the person, is possible to be improved after exercises, and the memory capacity will be increased. Especially, in Mathematics, as it has been noted by many researchers, the memory and various functions, play a determining role. Accordingly, the sixth and the seventh questions of the questionnaire were about the teachers' perceptions concerning memory and learning of Mathematics (Figure 3.6). From the results of the questionnaire, it was found that a total of 70% agree that memory plays a determining role in Mathematics, whilst 30% disagree with this statement. In comparison, these results were very similar to those concerning teachers' perceptions on the facilitation of the mnemonic function of students with intellectual disability, while using the specific digital game during teaching. 80% believe that the specific digital game will facilitate the mnemonic function of students with intellectual disability, whilst only 20% disagree with that statement. These results are in accordance with those reported by Hall and Gold (1990), who stated that if a person finds the information enjoyable and exciting, adrenaline exudes, which increases the level of glucose in the blood that is available to the brain, and as a result, it facilitates the mnemonic function and the consolidation of memories.

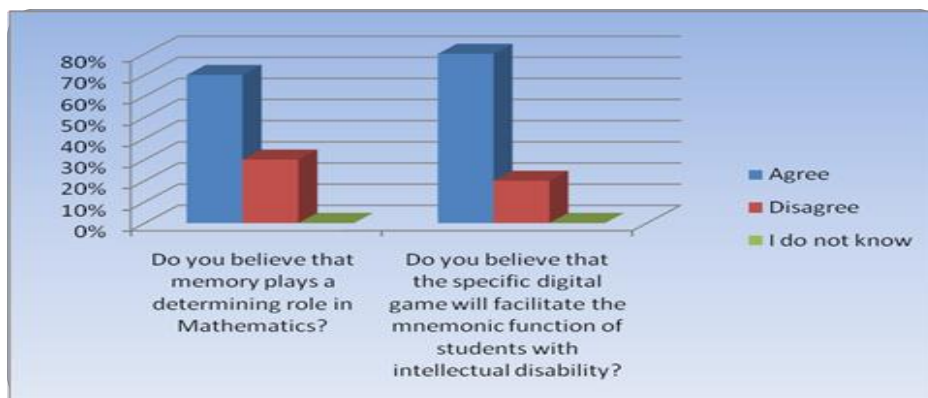


Figure 3.6. Teachers' perceptions concerning memory and learning of Mathematics

3.1.4 Memory and attention

Moreover, one of the factors which was examined through the questionnaires, was whether the digital game “Four Forces” will help the consolidation of memories of students with intellectual disability (figure 3.7). Among the participants, 77% agree, 20% disagree while only 3% do not know. According to the model of Norman and Shallice (1980), the memory of an event is directly linked to the attention given by the person when the stimulus is caused. Additionally, it is obvious to all investigations that the result in a work is a combination of both memory and the attention that the individual shows.

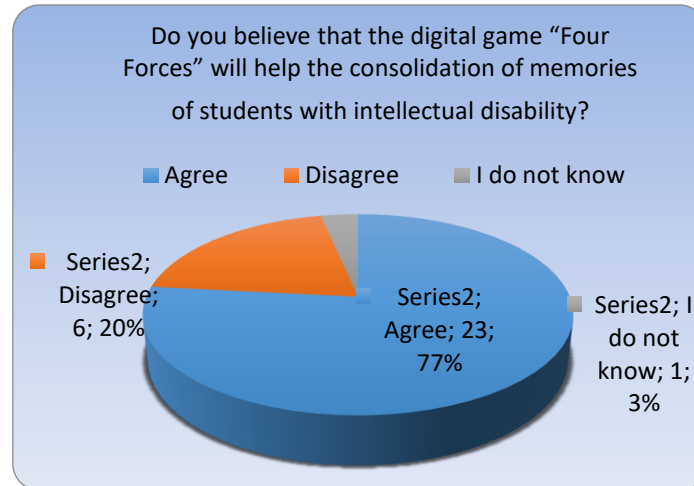


Figure 3.7. Teachers’ perceptions concerning the consolidation of memories of students with intellectual disability by the help of the digital game the “Four Forces”

Furthermore, from the questionnaire it was determined that 70% of the teachers agree that most of the correct answers to each section of the digital game are a combination of both memory and attention of each student, while 23% disagree with the above statement and only 7% do not know (Figure 3.8). These results are in accordance with those reported by Goldman et al., 1998, who stated that if the student at a complicated arithmetic problem has not in his mind with directness and clarity the data, and he needs to commit a significant portion of his attention and his short-term memory, then, he gets tired, and he cannot respond adequately to all the claims of a complex project.

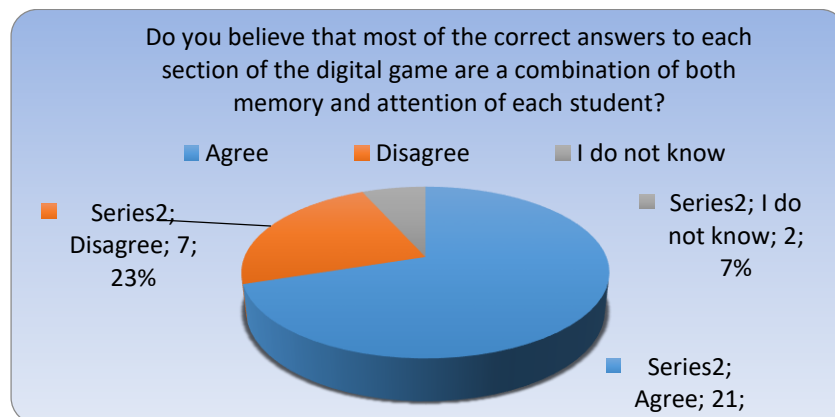


Figure 3.8: Teachers’ perceptions concerning that most of the correct answers to each section of the digital game are a combination of both memory and attention of each student

3.1.5 Memory and mathematics

One major factor that was also researched through the questionnaire was teachers' perceptions on memory and Mathematics (Figure 3.9). In the tenth question from the questionnaire an overwhelming total of 76% recognise that the initial part of the digital game, which is relevant to the theory of each mathematical unity, helps the memorization of students with intellectual disability, while only 24% of the teachers do not agree with this statement. The above results are similar to those reported by Skemp (1976), who notes that the understanding may be an instrumental understanding, which among others, supercharges the memory or the relational understanding, which besides being maintained more easily in the memory, it is also adjustable in new situations and can form the basis for further conceptual development. Moreover, the majority of the teachers, a percentage of 78%, agree that the digital game "Four Forces" helps most students with intellectual disability to maintain in memory mathematical concepts, while, on the other hand, it is encouraging that only 22% of the respondents disagree with that statement.

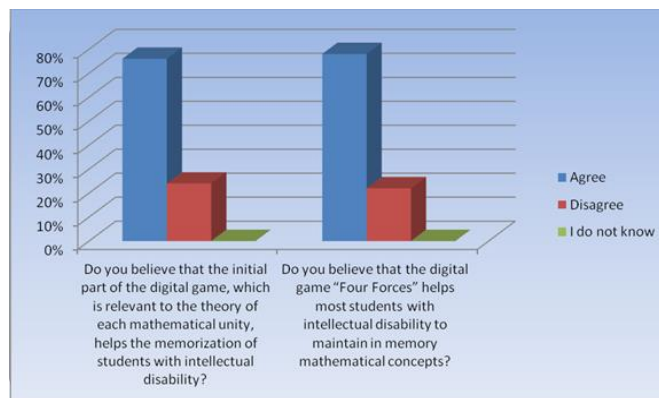


Figure 3.9. Teachers' perceptions concerning memory and Mathematics

The twelfth question was whether the specific digital game will help students with intellectual disability adjust mathematical concepts in new situations in their everyday life (Figure 3.10). It was found that the majority of teachers, a total of 63%, agree with the statement, whilst 37% disagree.

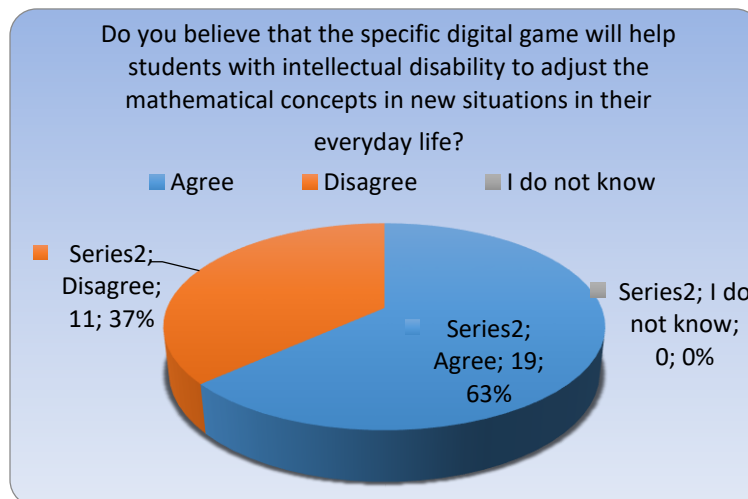


Figure 3.10: Teachers' perceptions concerning whether the specific digital game will help students with intellectual disability adjust mathematical concepts in new situations in their everyday life

3.1.6 Metacognition-metamemory

Furthermore, through the questionnaire, was researched the teachers’ perceptions on whether the specific digital game is an appropriate tool in order to make pupil’s metamemory more effective (Figure 3.11). Among the participants, 46% agree, 43% disagree while 11% do not know. As it is observed, there is a strong correlation between the answers. From the literature, it was found that the term metamemory is part of the phenomenon of metacognition and means awareness of the existence of memory as well as the knowledge that memorizing ability can be made more effective by using the appropriate method each time and in the specific case is the daily use of the digital game during the teaching.

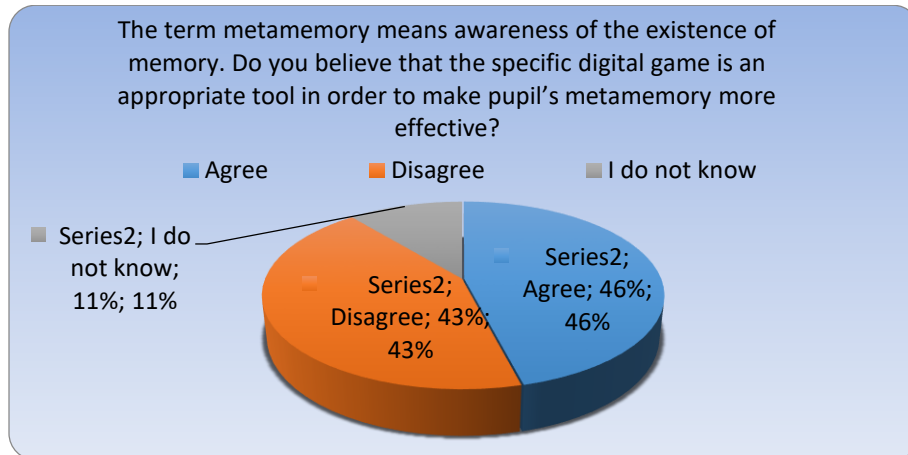


Figure 3.11. Teachers’ perceptions on whether the specific digital game is an appropriate tool in order to make pupil’s metamemory more effective

Furthermore, from the questionnaire it was observed that 63% of the teachers agree that the “Four Forces” will help students with intellectual disabilities develop math strategies more easily, while 27% disagree with the above statement and only 10% do not know (Figure 3.12).

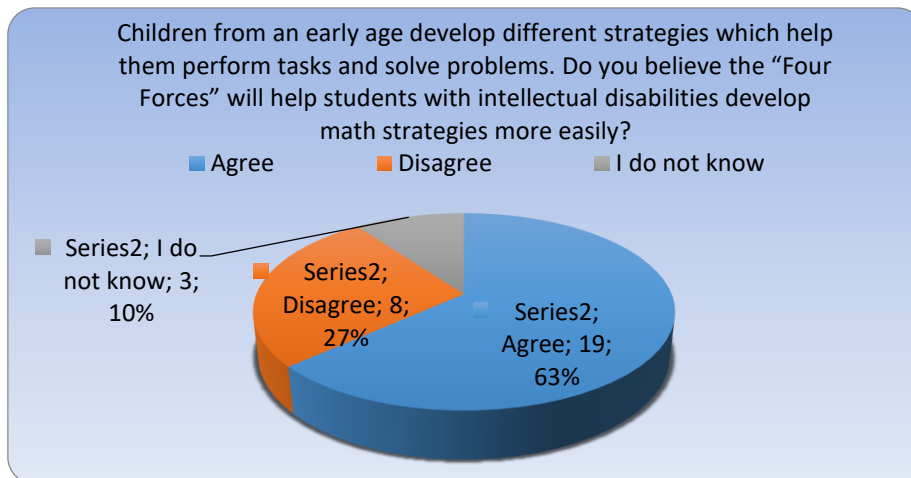


Figure 3.12. Teachers’ perceptions on whether the “Four Forces” will help students with intellectual disabilities develop math strategies more easily

The fifteenth question was whether the “Four Forces” help the self-regulatory of cognitive behavior of those students (Figure 3.13). The majority of the respondents, a percentage of 73% agree with the above statement, with 23% of them disagreeing and 4% not know. The above

results are similar to those reported by Wong and Jones (1982), who notes that the self-regulatory of cognitive behaviour of students, which is the conscious modification of behaviour by the individual in order to achieve a goal, is another basic difficulty posed by students with learning disabilities, which can be taught.

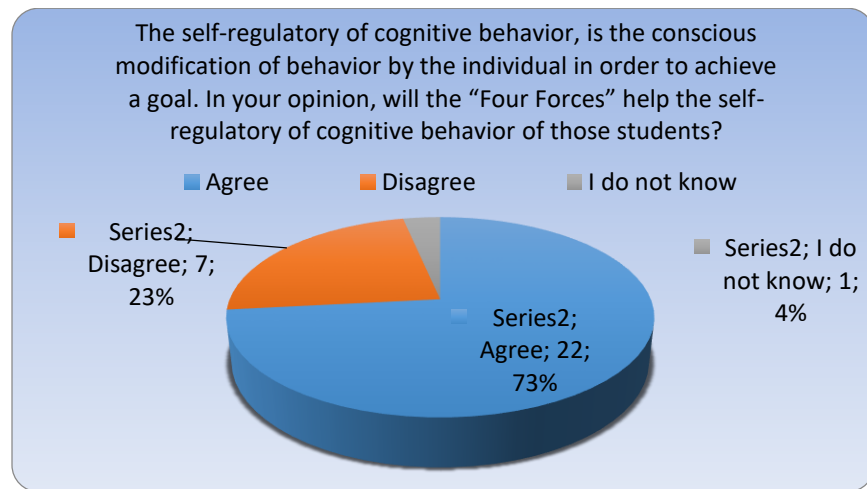


Figure 3.13. Teachers’ perceptions on whether the “Four Forces” help the self-regulatory of cognitive behavior of those students

3.1.7 Learning difficulties in mathematics

Another major factor that was also researched through the questionnaire was teachers’ perceptions on whether the digital game the “Four Forces” help students with intellectual disabilities face learning difficulties in Mathematics (Figure 3.14). Specifically the sixteenth question was about whether the specific digital game helps students with intellectual disabilities face difficulties in numbering and measuring, ascending or lowering the line, as well as difficulties in understanding the meaning and value of numbers. An overwhelming total of 72% agree with the statement, with only 28% of them disagreeing.

Furthermore, from the questionnaire it was determined that 77% of the teachers agree that the “Four Forces” will help students with intellectual disability learn how to select and use appropriate strategies in order to recall basic numerical data of a mathematical problem, whilst only 23% of them disagree with this statement.

The eighteenth question was whether the specific digital game will help students with intellectual disabilities restructure and use the mathematical models and rules that have been taught in new contexts, since it is characteristic that these children usually remain “devoutly” committed to the way they have received the knowledge. The majority of the respondents, a percentage of 74% agree. However, only 26% has the opposite opinion. These results also conform to the findings of Tishler (1981), who advises that these children usually remain “devoutly” committed to the way they have received this knowledge, unable to proceed to the reconstruction and use of mathematical models and rules that have been taught in a new context, presenting a cognitive rigidity.

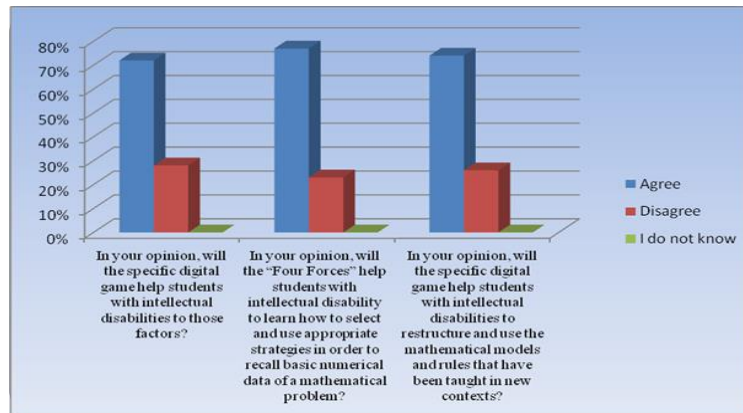


Figure 3.14. Teachers’ perceptions on learning difficulties in Mathematics

3.1.8 The digital game

Moreover, through the questionnaire, was examined the digital game the “Four Forces”, which was created (Figure 3.15). Among the participants 79% agree with the statement that the digital game will help students with intellectual disability understand better and remember mathematical symbols while a 21% tend to disagree with this statement. Additional, in this survey the findings illustrate a percentage of 87% of the participants who believe that the “Four Forces” will help students with intellectual disability understand better geometric shapes. 80% agree with the statement that the digital game will help students with intellectual disability to identify better symmetry and patterns in everyday life, whereas 20% have a different opinion. Concerning the learning of better conception of time by using the specific digital game, 81% of the participants agree, whilst only 19% of them disagree with the statement. Moreover, 83% of the teachers agree that the “Four Forces” will help students with intellectual disability learn better and be able to distinguish the months and the seasons on the other hand, 17% of the participants disagree with the statement. The majority of teachers, a total of 84%, agree that the specific digital game will help students with intellectual disability learn easier about Euro money, with only 16% disagreeing with this statement. Last but not least, 70% of the participants agree with the statement that the “Four Forces” will help students with intellectual disability learn easily the value of money and consequently the term of savings.

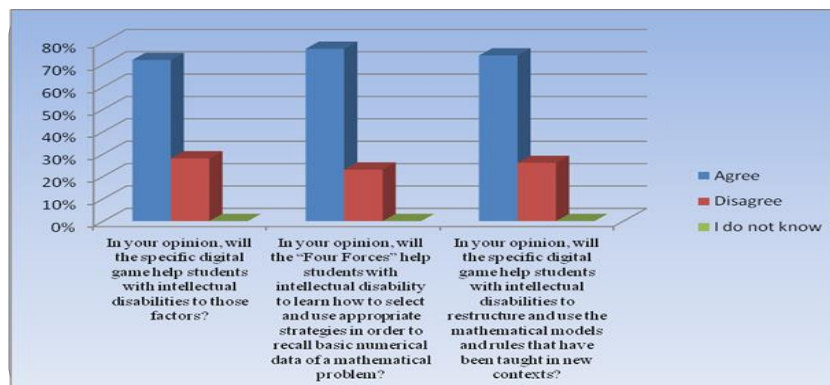


Figure 3.15. Teachers’ perceptions on the digital game

3.1.8 General perception

The main finding of the survey is that most of the teachers believe that the digital game the “Four Forces” will affect on the development of both the mnemonic capacity and the numerical skills of students with intellectual disability (Figure 3.16). The majority of the respondents, a percentage of 93% agree. However, only 7% has the opposite opinion. Finally, none of the participants are neutral.

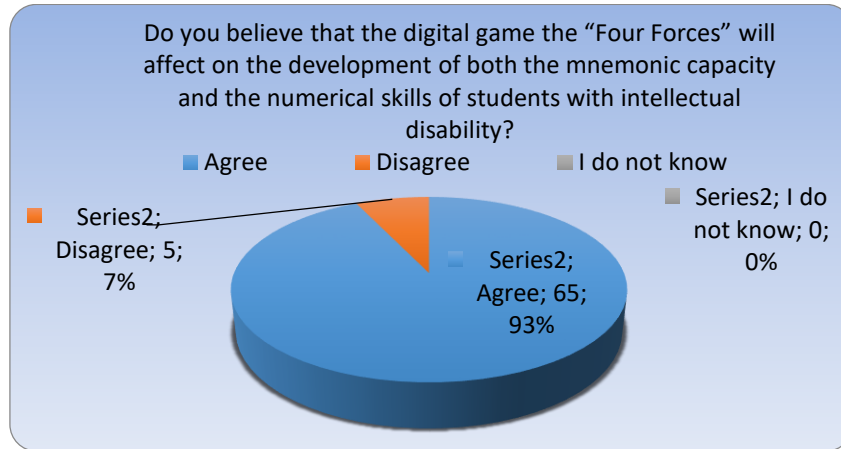


Figure 3.16. Teachers’ perceptions on the digital game

The special need teachers who took part in the specific research, they also answered in an open question, the following one: “Do you believe that the digital game the “Four Forces” you have been given can be improved?” Specifically 80% of the participants believe that the digital game the “Four Forces” does not need to be modified in order to be improved whilst only 20% from them has a contrary view (Figure 3.17).



Figure 3.17. Teachers’ perception on whether the digital game the “Four Forces” can be improved

3.1.9 Correlations and conclusions

Comparison between the highest and the lowest rates

The highest rate is detected in the general question where the participants have to answer whether the digital game the “Four Forces” will affect on the development of both the mnemonic capacity and the numerical skills of students with intellectual disability. 93% of the respondents tend to agree with the above statement. The lowest value is zero and is observed in the answer “I do not know”. Furthermore, there are also some questions with the lowest value.

These are the general question as mentioned above and the twentieth question, “Do you believe that the “Four Forces” will help students with intellectual disability understand better geometric shapes?” (These two questions have been also chosen, because they also conclude the highest value of the statement “Agree”).

Comparing totals

The highest value is observed in the general question, with 93%, and the lowest value is detected in the thirteenth question (“The term metamemory means awareness of the existence of memory. Do you believe that the specific digital game is an appropriate tool in order to make pupil’s metamemory more effective?”) with a percentage of 46%. Most significantly is that the general question also includes the lowest rate, with a percentage of 7%, and moreover, the 13th question, has the biggest value of the statement “Disagree” with 43% (Figure 3.18). The above totals suggest that almost everyone agree that the digital game the “Four Forces” could enhance students’ cultivation of memory capacity and improve the development of numerical skills.

Last but not least, the 13th question shows that there is a strongly correlation between the answers of the teachers concerning metacognition and metamemory.

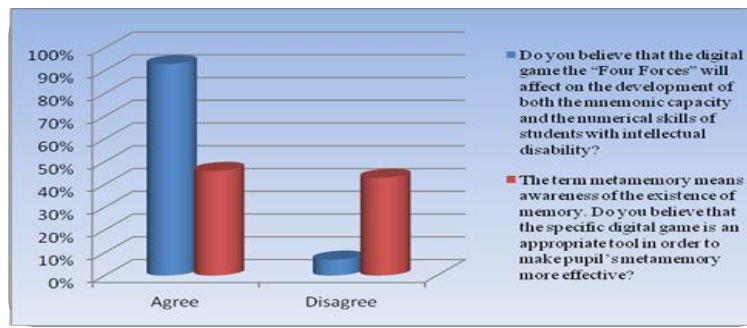


Figure 3.18. Highest and lowest total values

4. Discussion and conclusions

Proficiency in mathematics is a major determinant of a pupil’s future success. A comprehensive teaching approach and also teachers’ perceptions about students with intellectual disabilities are necessary to address the many problems those pupils face during their school life.

The digital game the “Four Forces” will help to develop the students’ knowledge and furthermore is going to help them successfully participate in all the educational situations that negotiate important concepts of Mathematics and memory.

Participants’ answers show that they believe, that the specific digital game helps the students’ memory and intellectual development, and furthermore it plays a significant role in the development of their mathematical thinking. From the questions of the questionnaire, as well as from the general question, the learning value of the game is highlighted, which will contribute positively to the whole educational process.

Through the use of the digital game the “Four Forces”, an effective learning environment is being created, as mathematical concepts are presented in a more specific and attractive way to the student, aiming at reducing pupils’ fears for Mathematics.

In this study, all the data are divided into six categories so as the validity of the results to be more understandable: These categories concern “Memory and Learning”, “Memory and Attention”, “Memory and Mathematics”, “Metacognition-Metamemory”, “Learning difficulties in

Mathematics” and “The Digital Game”. A general perception and an open question are also included.

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