Designing a Database of Research Papers Focused on Teaching Science to Students with Learning Disabilities

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ABSTRACT— ***The Department of Special Education at the University of Thessaly is in the process of setting up a scientific database called: "Bibliography Observatory". This database collects and processes scientific publications focused on teaching science to students with learning disabilities, in order to promote Special Education research and teaching. In this paper we present the distribution of 40 research papers included in the Observatory regarding science domain of interest, science courses in each domain, students' activities carried out, means of data collection, and number of participants per education level. The digital archiving of these research papers and the study of their distribution in the aforementioned categories will help researchers understand the trends of research on teaching science to students with disabilities. It will also help teachers and teacher candidates to select research papers that will enrich their lesson plans if they search the Observatory using the proposed in our paper key words that emerged from the study of the research papers.***

Keywords— Learning Disabilities, Science Education, Research Paper, Bibliography Database

1. INTRODUCTION

Science Education for students with Learning Disabilities (LD) has been the topic of intense investigation within the educational community for many years, while the results of the investigation have been a vigorous topic of discussion [1]. The degree of active participation of LD students in science classes highly depends among others on their knowledge and understanding of the natural world and it is reflected on their performance at school [2]. Over the past few years an effort is being made on improving teaching approaches in the science classroom to make them more suitable for LD students. There are also educational interventions available for science classes that apply to both students with or without learning disabilities [3]. According to Brigham, Scruggs & Mastropieri's review [4], the implementation of specific science teaching practices for LD students like exploratory learning differentiation, has been beneficial.

In many cases, these practices remain just a part of a theoretical approach that is not practically applied to education [5]. Science teachers usually use approaches based on their experience while most of them are not aware of the new alternative methods available that are based on experimental research [6]. Consequently, teachers are often disappointed since their approaches are not effective for LD students, and LD students deal with failure. Therefore, it seems extremely important for teachers to have access to all scientific literature available focused on new methods to teach science to LD students. As it is mentioned, at the proposal for further education of teachers, from the Pedagogical Institute of Greece [7], there is a gap in teacher training regarding: i) special education practices, ii) the implementation of new alternative

teaching approaches that could be beneficial for LD students, iii) the use of information technology in the classrooms, iv) the introduction of modern assessment methods for all students and v) the discovery of new teaching approaches for its subject that would facilitate knowledge acquisition for LD students [8].

Access to scientific knowledge and the experimental data is crucial to promote research in education and for inservice training of teachers. Therefore, the Department of Special Education at the University of Thessaly is in the process of setting up a scientific database named "Bibliography Observatory". This database collects and processes scientific publications focused on teaching science to LD students in order to promote special education research and to offer these research data to science teachers who want to enrich their everyday educational practice. In this study we describe the characteristics of this Observatory as well as its functions. Our goal is to communicate scientific knowledge to science teachers and researchers and keep them updated for any new achievements on the area of science teaching to LD students.

2. SETTING UP THE OBSERVATORY

2.1 Collection of Publications of Interest

The ERIC (Education Resources Information Center) database as well as international journals specialized in Special Education were used to locate scientific publications on teaching science to LD students. The location of research publications of interest was based on the following keywords: learning disabilities, learning difficulties, science instruction, reading difficulties, dyslexia, science teaching, science education, low achievers, special education, disabilities, science learning. The Greek publications were located through the database of the Issue of Educational Papers as well as Greek journals of educational and pedagogical interest.

2.2 Processing of Research Papers

The research papers of interest were selected through the information available at their abstracts in order to classify them as experimental research units. The elements that have been verified through the abstracts were: the actual implementation of the experimental research, the reference of the number of subjects in the experimental and the control group. We also recorded the full reference of each article: the title, the authors, the volume and issue of the journal, and the page numbers. We proceeded by locating the papers to which we could have full access through the Heal Link and recorded the full URL address for each one and took into account the key words that ERIC records and the key words determined by the authors themselves.

Qualitative content analysis for the selected research papers was carried out in order: a) to identify the putative keywords that a teacher would use to access scientific papers related to his usual teaching practices, b) to make a statistical analysis to reveal the scientific trends towards certain stages of the experimental research of interest. Therefore, we analyzed parts of the papers concerning the aims, the teaching methods supported, the suggested students' activities, the methodology used to collect the presented research data as well as the scientific subject selected for teaching.

For the keyword selection, content analysis method was followed using each paper as a unit [9]. For the extrapolation of the statistical data, subjects of general interest for researchers in the education field and subjects that practically contribute to the area of teaching science to LD students were used. This analysis resulted in the location of a group of new keywords that were added to the existing ones from the ERIC and the authors of each research paper.

2.3 Observatory Data

From the content analysis of the papers (see Appendix) that we had full access (N=40) when we were preparing this paper, we concluded the following:

2.3.1 Science domain of interest

Most of the papers analyzed were focused on teaching of Physics (24 out of 40) and Life Sciences (15 out of 40). Investigators were also focused on Earth Sciences as well as Science as inquiry (7 papers out of 40) to a lesser extent. Technology was the focus of only one paper from the ones we collected. Interestingly, most of the authors focused on two different domains of Science in each research paper while there is one publication where 4 domains of Science are analyzed at the same time. Statistical analysis for the domain of Science that the papers of the Observatory are focused on, is given in Figure 1 until further update is available.

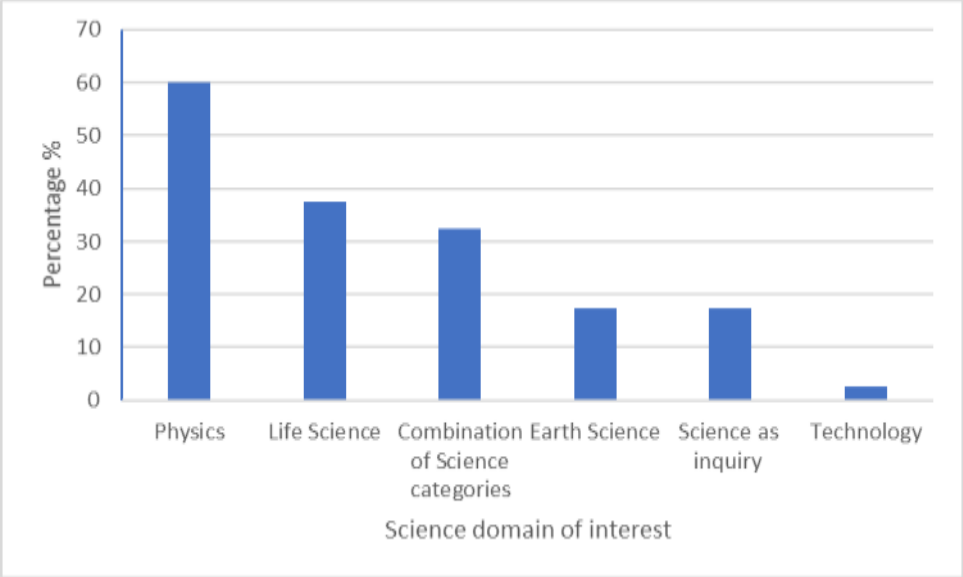

Figure 1: Distribution (%) of the Science Domain of interest used in the papers

Keywords that were added to our database include: physics, earth science, life science, technology, etc.

2.3.2 Science courses in each domain

For the research articles focused on teaching Physics, the preferable courses electromagnetism and the nature of light were and there was a clear reference to electric charge, electric circuits, conductors and insulators, magnetic properties of materials and light-material interactions. Fewer papers focused on other courses of Physics such as density, mechanics and thermal energy and topics like chemical reactions, acids and pH. 25% of the articles of Life Sciences focused on bloodstream, while others focused on the study of a living organism or of an important organ like the heart. 40% of the research articles focused on Earth Science did not refer to a specific course of interest while the other 60% focused on the composition of earth, study of rocks and minerals. Finally, half of the papers focused on Science as a research method, scientific thinking and set up of a scientific experiment were analyzed. Statistical data will be presented at the Observatory as shown in Figure 2 until further update is available.

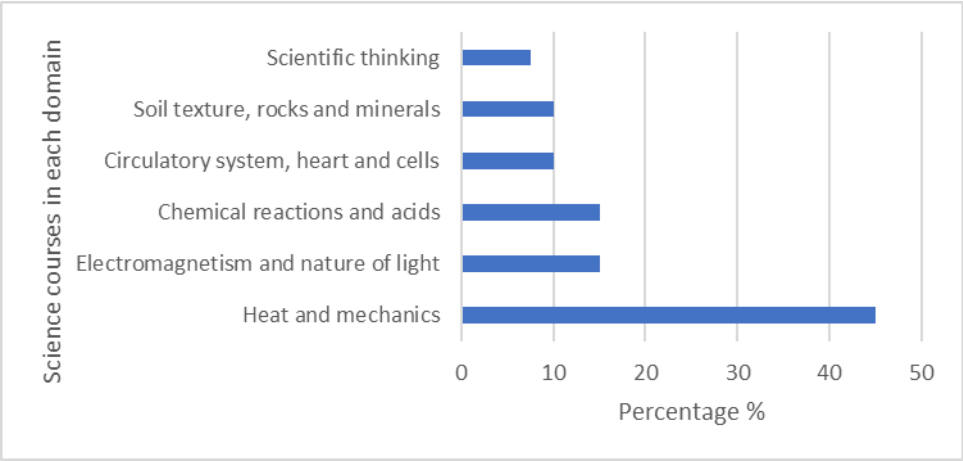

Figure 2: Distribution (%) of the Science Courses in each domain

Keywords that were added to our database include: electromagnetism, nature of light, electric charge, electric circuits, conductors, insulators, density, etc.

2.3.3 Students' activities

In 25% of the papers analyzed, students were asked to carry out activities based on printed material, such as filling out a questionnaire or designing a graph (textbook activities). In contrast, in 42.5% of the papers students had a more active role, such as performing structured experiments in the lab, designing electric circuits, or examining rocks and seeds. Finally, in 12.5% of the studies students were asked to carry out both textbook and laboratory activities. It is noteworthy

that only 5 studies among the ones analyzed here included a computer based activity. There was one study where the students were asked to fill in a 20 task test on a computer screen. In any case though, in 2/3 of the papers analyzed, description of the students' activities is not presented in detail. So, the available material for teachers to use directly restricts to 13 research papers. Statistical analysis of the data concerning the students' activities presented in the papers included in the Observatory appear in Figure 3, until further renewal of the data.

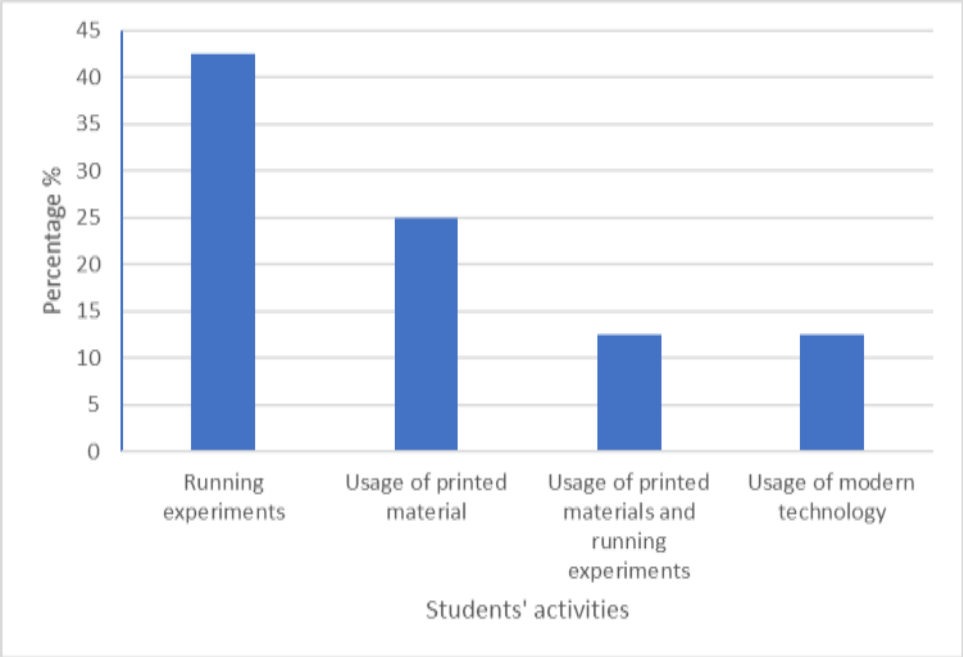

Figure 3: Distribution (%) of the students' activities that were described in the papers

Keywords added in the database include: laboratory activities, hands-on activities, printed material, computer based activities, etc.

2.3.4 Data collection

Means of data collection varied a lot among different research studies. In most of the studies more than one data sources were used. Data were mostly collected form students' notes, assignments and portfolios, as well as from the results of a written test that students had to perform before and after the teaching intervention. 25% of the researchers collected data from students' notes and 6 collected data from assignments, written tests and portfolios. Interviews were also used as a data source from 22.5% of the researchers, while 17.5% chose the video recording and 12.5% based the data collection on simple observation. There was only one study where the data were digitally collected using the hard disc of a computer. Statistical data for the above analysis will be presented as shown in Figure 4 until further update is available.

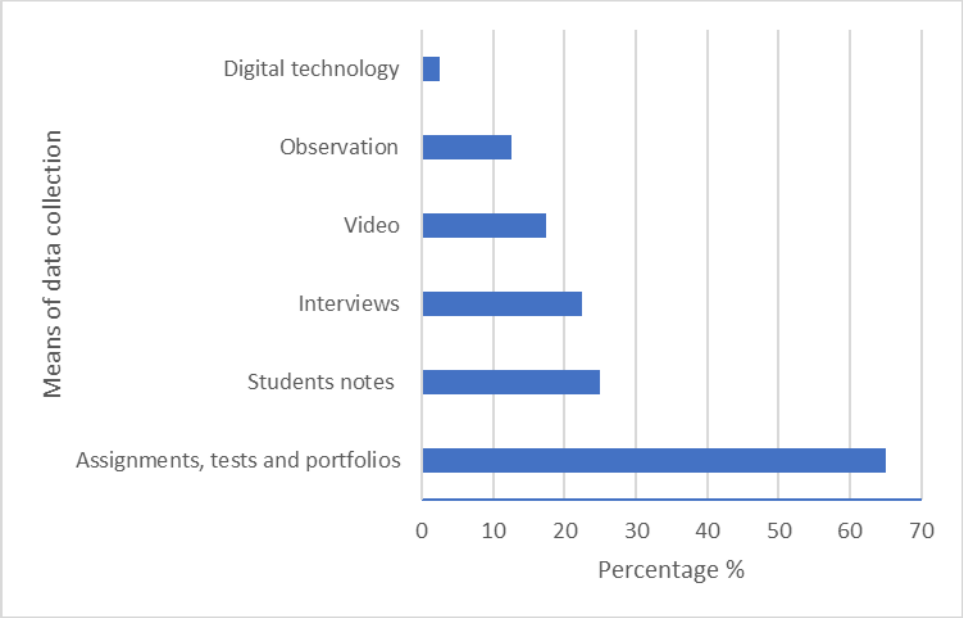

Figure 4: Percentages (%) of Means of Data Collection used in the papers

Additional keywords for the Observatory include: modern technology, observation, video recording, interview, students' notes, tests, assignments, portfolio.

2.3.5 Sample

The number of participants (students) was different among the research studies. Most of the studies compared a control group (typical students) to the research group (LD students). Students' age groups were always correlated. It is noteworthy that 2 papers only used teachers of Physical Sciences as their research sample instead of students while in 3 other papers there was extensive research for student groups of primary and secondary education. More closely, 35% of the papers referred to primary education students, 50% to secondary education students, 7.5% referred to both education groups (joint grade level), 5% to teachers of science and 2.5% to tertiary education. Statistical data for the analysis will be presented as shown in Figure 5 until further renewal of the data.

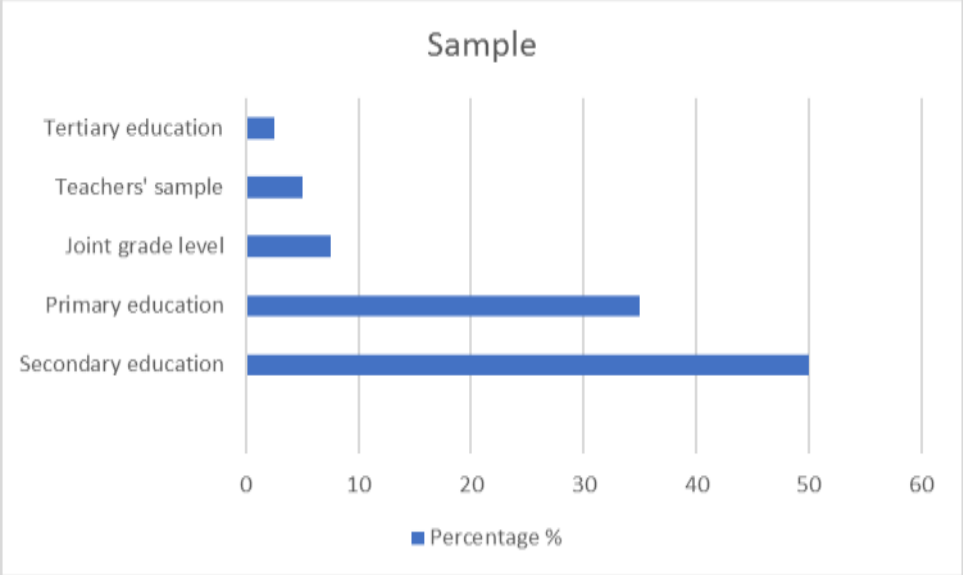

Figure 5: Distribution (%) of the samples described in the papers

Additional keywords for the Observatory include: tertiary education, teachers' sample, joint grade level, primary education, secondary education, etc.

3. DISCUSSION

The construction of the Observatory at the Department of Special Education at the University of Thessaly is the result of long term studies that graduate and postgraduate students of the Department, teachers specialized in Special Education as well as researchers in collaboration with members of the scientific staff of the Department conducted successfully. We believe that continuous update of the Observatory as well as processing of the new published papers of interest for extrapolation of statistical data and the identification of additional keywords could be an interesting discipline for any student of our Department.

Moreover, according to the analysis of the research papers that has been described in this article, we consider that the Observatory will be a useful tool for new researchers to gain knowledge about the trends in the field and therefore to decide where to direct their own research. We believe that they will have the opportunity to acquire an overall opinion of the research in teaching science to LD students and to point out the research objectives and tools other researchers have used to fulfill them. This may enable them to find out the limitations of other studies and expand their own research in these territories. Additionally, the Observatory could help active science teachers to enhance their teaching techniques with the laboratories and hands-on activities that are proposed by academics. It is a fact that only a small minority of the researchers have described with details the activities they used, nevertheless the teachers could still get an idea. What is more, the Observatory is a dynamic situation, which means that in the future may more researchers provide an exact description of their tools. However, assessing the usefulness of the Observatory to teachers in practice and the improvement of the Observatory could be a future research subject itself.

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6. APPENDIX

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