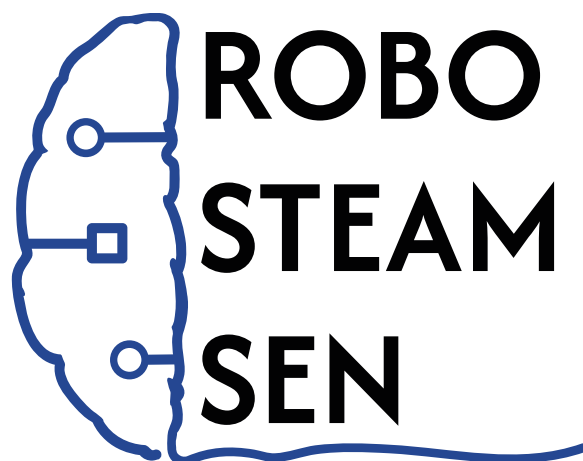


WP2.T1 Analysis and extraction of the main features to be considered to classify students with IDD.

“WP2. Adapting Resources, Methodologies and Tools by IDD”



**Training SEN teachers to
use ROBOTICS for fostering
STEAM and develop
computational thinking**

Project No. 2023-1-ES01-KA220-SCH-000155379



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1. Aim of this report

This report aggregates the findings from the WP2.T1 activity, which comprises two distinct segments as outlined in the project proposal:

“For describing properly the taxonomy and user model is necessary to build a knowledge base about IDD. This requires an analysis of the different disabilities based on a systematic literature review (carried out by the universities) and also to ask the experts involved through the partnership institutions and the associated partners by using surveys (led by the schools).”

In undertaking this task, it is imperative to examine existing studies and to delve deeper into the knowledge of experts on Intellectual and Developmental Disabilities (IDDs) within the partnership. The former can be addressed through a systematic literature review (SLR) and/or a systematic mapping study (SMS). An SLR is a methodological framework that aggregates and critically appraises multiple studies or research papers via a systematic procedure [1]. Originating in the medical field and later adapted to technology by Kitchenham [2, 3], this methodology facilitates the selection and analysis of scientific literature in a replicable and verifiable manner. The SLR aims to seek and synthesize information pertinent to very specific inquiries, whereas mapping provides a comprehensive overview of research within a certain domain [4, 5]. The findings from the SLR are elucidated in section 2 of this report.

With regard to the compilation of expert knowledge, a template has been devised to capture their insights and has been circulated among the educational partners, enabling them to solicit input from teachers and therapists who work with students with IDD. This portion is explicated in section 3.

2. SLR

In this section we presented the Systematic Literature Review carried out. An SLR was selected because the objectives of the research question to deal with were very concrete and specific and it was not necessary a mapping to understand the context of IDD in Education. The work has been distributed between the universities of the partnership through a template (Figure 1). The compilation of the results gathered by them are shown into the next subsections.

1. → Aim of the SLR¶

This template is the basis to build the Systematic Literature Review described to be carried out in the project proposal during WP2.T1. More specifically we asserted:¶

“For describing properly the taxonomy and user model is necessary to build a knowledge base about IDD. This requires an analysis of the different disabilities based on a systematic literature review (carried out by the universities) and also to ask the experts involved through the partnership institutions and the associated partners by using surveys (led by the schools).”¶

Given this task, it is necessary to analyze the existing works and in this sense it is possible to carry out a systematic literature review (SLR) and/or a systematic mapping (SMP). The systematic literature review (SLR) is a type of review that collects and critically analyses multiple studies or research works through a systematic process [1]. This type of methodology, coming from the field of medicine and was adapted to the technological context by Kitchenham [2, 3], allows approaching the selection and analysis of scientific publications following a replicable and verifiable process. The SLR is focused on answering and look for information related to very specific questions while the mapping allows obtaining a panoramic view of the studies in a specific area [4, 5].¶

2. → Planning the review (answers before the 1st of November)¶

2.1. Topic and research question¶

The topic to deal with is IDD's features in Education and if possible related to Technology and STEAM based on this propose a possible research question.¶

2.2. Sources¶

Name three sources for the SLR.¶

2.3. Inclusion and exclusion criteria¶

Define three inclusion and exclusion criteria. For instance:¶

- → Paper published in a peer review journal or conference.¶
- → Published after the year 2.000.¶
- → Written in English.¶

2.4. Quality assessment¶

Define at least three quality assessment questions:¶

- → Does the paper describe the features of students with IDD in education?¶
- → Is the paper based on research or is it merely a report based on expert opinion?¶
- → Is there a description of the context in which the research was carried out?¶

2.5. Data extraction Questions¶

Define at least one data extraction question. Sample:¶

- → Which are the main difficulties found in educational activities for students with IDD's?¶

Figure 1. – SLR Template (REF to the webpage)

For the SLR development parsif.al online tool was used. It allows the distribution of work among different users (one per university) and the implementation of the different phases, the planning, conducting and reporting.

2.1. Planning the review compilation

2.1.1. Topic and research question

As a first step of the definition the research questions is important to set up the scope of the research. In this sense we are going to use a protocol known as PICOC (Population, Intervention, Comparison, Outcome, Context) [6]. This is to establish

- Population: Who represents the problem or situation being addressed?
- Intervention or Exposure: How are you considering intervening in the situation? What kind of options do you have to address the problem?
- Comparison: What is the alternative? This is optional.
- Outcomes: How do you measure? What do you want to achieve?
- Context: What is the particular context of your question?

In our specific case we have defined the PICOC as follows:

- Population: Students with IDD.
- Intervention: Application of Robotics and Active Learning Methodologies
- Comparison: -
- Outcomes: Skill improvement, sensory integration, emotional regulation.
- Context: STEAM Education

As a final result we have defined the following research questions merging those similar between the defined by the partners.

- RQ1. How can educational robotics and active learning methodologies support intellectual and developmental IDD students in STEAM Education?
- RQ2. What are the features of user model of a IDD person?
- RQ3. How does the customization level of technologies impact the learning outcomes and engagement of students with IDD in the field of STEAM Education?
- RQ4. What are the specific social and communication skill improvements observed in STEAM students with IDD when engaging with socially interactive robots/ technologies?

- RQ4. To what extent do robotics-based interventions contribute to enhancing sensory integration and emotional regulation among STEAM students with IDD?

2.1.2. Inclusion and exclusion criteria

To enhance the precision of the initial search phase results, we established specific inclusion and exclusion criteria to be applied to the identified documents. We carefully reviewed the titles and, when necessary, the abstracts to determine their relevance. This review process was aimed at discerning whether the documents satisfied the inclusion criteria or if, conversely, they should be excluded from further analysis. The inclusion criteria were as follows:

- IC1. Applied robotics within an active learning methodology.
- IC2. Describe students features.
- IC3. Describing current class experiments with disabled students.
- IC4. Paper published in a peer review journal or conference.
- IC5. Paper text reachable.
- IC6. Published papers with primary data or case studies.
- IC7. Works that described experiences with IDD students.
- IC8. Written in English.
- IC9. Written in the last 10 years (since 2013).

Exclusion criteria:

- EC1. Do not describe students features.
- EC2. Just theoretical papers about these topics.
- EC3. Not describing current class experiments with disabled students.
- EC4. Not written in English.
- EC5. Paper not published in a peer review journal or conference.
- EC6. Papers do not applied robotics or active learning methodologies.
- EC7. Published papers that without primary data or case studies.
- EC8. Unreachable paper.
- EC9. Works that do not described experiences with IDD students.
- EC10. Written before 2013.

2.1.3. Quality Criteria

The following quality assessment criteria have been established for the pertinent documents to ensure that only those of acceptable quality are selected for subsequent data extraction. The quality will be assessed by using the following questions that can be answered with yes/no/partial.

- QC1. Is there a clear statement of the aims of the research?
- QC6. Was the data collected in a way that addressed the research issue?
- QC2. Was the data analysis sufficiently rigorous?
- QC3. Is the paper based on research or is it merely a report based on expert opinion?
- QC4. Is the study of value for research or practice?
- QC7. Was there a control group with which to compare the results?
- QC5. Is there a clear statement of findings?
- QC8. Was the recruitment strategy appropriate to the aims of the research?
- QC9. Was the research design appropriate to address the aims of the research?
- QC10. Is there a description of the context in which the research was carried out?
- QC11. Is there a real application with IDD students beyond to mention them and is it described?
- QC12. Is the educational intervention carried out in several of the STEAM disciplines?
- QC13. Are improvements or outcomes of the intervention clearly specified?

2.1.4. Data extraction questions

After selecting the elements that adhered to the set quality criteria, the subsequent phase involved extracting data from these sources to address the research questions. To facilitate this process, a form was created, featuring the following questions for data extraction:

- EQ1. Which are the features of the students with IDD? (Specify disability, level and if they present one or several IDD)
- EQ2. Which is the technology used for students with IDD?
- EQ3. Which are the methodologies used for students with IDD? (If there is any agile methodology please mention and describe how it is adapted))
- EQ4. Which characters / behaviours of IDDs are likely to respond to technology stimulation?
- EQ5. Are they using robotics? Which type?

- EQ6. Which are the improvements in students with IDD learning motivated by the use of the technology? (Attend to the Polloway classification to answer, I have sent it to you by email)
- EQ7. Describe the improvement in students with IDD learning

2.1.5. Sources and search string

The initial phase following the delineation of the context, research question, inclusion and exclusion criteria, and data extraction queries involves identifying the bibliographic sources and determining the search terms. These are contingent upon the specific research question, the elements of the PICOC framework, and relevant synonyms. In our study, the principal terms include:

- Terms related to the educational context, for instance: STEAM, STEM and Descriptions of the acronyms for STEAM/STEM.
- Terms associated with the individuals involved: Students with Intellectual or Developmental Disabilities (IDD), Alternative terms describing these disabilities.
- Terms concerning the tools or methodologies utilized: Robotics, Active learning methodologies.
- Terms connected with the expected results: Outcomes, Improvements, Interventions, Adaptations, etc.

Bearing these categories in mind, the general search string would be formulated as follows:

(STEAM or STEM or "Science, Technology, Engineering, Arts and Maths") AND ("Intellectual or Developmental Disabilities" or IDD) AND ("ROBOTICS" OR "Active Learning Methodologies") AND ("Outcomes" or "Improvements" or "Interventions" or "Adaptions")

It is necessary to consider the different possible sources, the possibility to use wildcards in the strings. Depending on that the search string could change. The decision for this SLR was to use generalist and specific sources as shown in section 2.2.1.

2.2 Conducting

2.2.1. Bibliographical sources

The sources considered and the results obtained for the SLR were:

- ACM: 0
- Assitive Technology Journal: 0
- DOAJ: 0
- IEEE: 0
- Pubmed: 200
- Scopus: 50
- Web of Science: 47

It is possible to see that although several databases both specific such as ACM and generalists such as WoS were considered not always results were reached. This can be motivated because of the specificity of the research question and because in some the databases quotation marks and more than a specific number of logical operands cannot be used.

However results are correct as at least two general sources such as WoS and Scopus have returned results and one specifically related with the health care sector also. The research strings obtained for the databases were:

```
(AB=((STEAM or STEM or "Science, Technology, Engineering, Arts and Maths" or "Science" or
"Technology" or "Engineering" or "Arts" or "Maths") AND ("Intellect* or Develop* Disab*" or IDD or
"intellect* disab*" or "develop* disab*" or "ment* disab*" or "ment* impairment" or "intellect*
impairment" or "ment* handicap*" or "intellect* handicap*" or "ment* defici*") AND ("outcomes" OR
"improv*" OR "result*" OR "interventions" OR "adapt*") AND ("Educ*" or "Lear*") AND ("Robo*" or
"Active Lear*"))) OR TS=((STEAM or STEM or "Science, Technology, Engineering, Arts and Maths" or
"Science" or "Technology" or "Engineering" or "Arts" or "Maths") AND ("Intellect* or Develop*
Disab*" or IDD or "intellect* disab*" or "develop* disab*" or "ment* disab*" or "ment* impairment"
or "intellect* impairment" or "ment* handicap*" or "intellect* handicap*" or "ment* defici*") AND
("outcomes" OR "improv*" OR "result*" OR "interventions" OR "adapt*") AND ("Educ*" or "Lear*") AND
("Robo*" or "Active Lear*"))) OR TI=((STEAM or STEM or "Science, Technology, Engineering, Arts and
Maths" or "Science" or "Technology" or "Engineering" or "Arts" or "Maths") AND ("Intellect* or
Develop* Disab*" or IDD or "intellect* disab*" or "develop* disab*" or "ment* disab*" or "ment*
impairment" or "intellect* impairment" or "ment* handicap*" or "intellect* handicap*" or "ment*
defici*") AND ("outcomes" OR "improv*" OR "result*" OR "interventions" OR "adapt*") AND ("Educ*" or
"Lear*") AND ("Robo*" or "Active Lear*")))
```

Search string for Web of Science

```
TITLE-ABS-KEY (( steam OR stem OR "Science" OR "Technology" OR "Engineering" OR "Arts" OR "Maths" OR
"Science, Technology, Engineering, Arts and Maths" ) AND ( "Intellect* or Develop* disab*" OR "idd"
OR "Intellect* disab*" OR "Develop* disab*" OR "ment* disab*" OR "ment* impairment" OR "intellect*
impairment" OR "ment* handicap*" OR "intellect* handicap*" OR "ment* defici*" ) AND ( "outcomes" OR
"improv*" OR "result*" OR "interventions" OR "adapt*" ) AND ( "Educ*" OR "Lear*" ) AND ( "Robo*" OR
"Active Lear*" ) )
```

Search string for Scopus

```
"query": { AllField:((STEAM or STEM or "Science, Technology, Engineering, Arts and Maths" or
"Science" or "Technology" or "Engineering" or "Arts" or "Maths") AND ("Intellect* or Develop*
Disab*" or IDD or "intellect* disab*" or "develop* disab*" or "ment* disab*" or "ment* impair*" or
"intellect* impair*" or "ment* handicap*" or "intellect* handicap*" or "ment* defici*") AND
("outcome*" OR "improv*" OR "result*" OR "interventions" OR "adapt*") AND ("Educ*" or "Lear*") AND
("Robo*" or "Active Lear*")) }
"filter": { E-Publication Date: (01/01/2013 TO 12/31/2023) }
```

Search string for Pubmed

It's crucial to note that revisions have been applied to the general search string. Initially, 'STEAM' has been defined both as a combined term and as separate disciplines to encompass a wider educational context. In the context of disabilities, an array of synonyms and wildcards has been introduced to ensure comprehensive coverage of the literature. Additionally, it has become necessary to incorporate a term related to 'education' or 'learning.' This is due to the dual meaning of 'STEAM,' which also refers to a type of cell studied in biological and healthcare sciences—a subject area that our search results should exclude.

2.2.2. Results of the application of search strings in bibliographic sources

Regarding the results obtained from the sources it is possible to see the distribution of papers per source in Figure 2, the accepted and rejected by source in Figure 3 and the distribution of papers by year in Figure 4 (keep in mind that this graph is built with the papers extracted from each source without the application of the time frame restriction defined as an exclusion criterium in EC10).

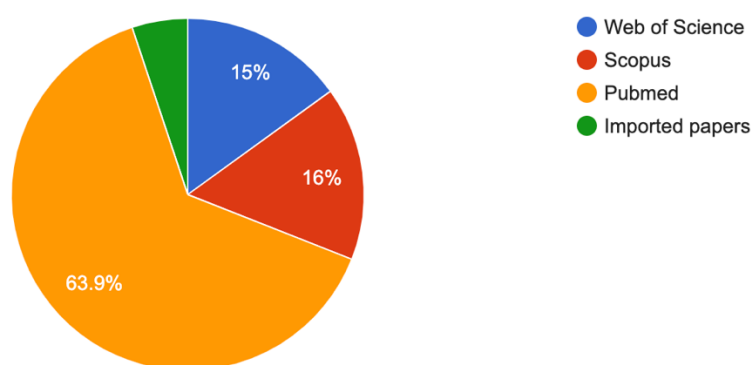


Figure 2. Distribution of papers by source

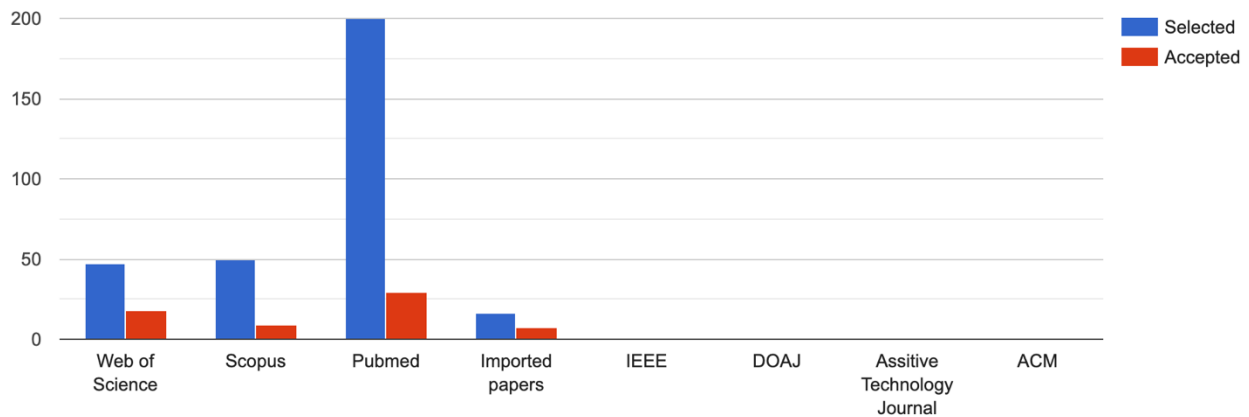


Figure 3. – Selected and accepted papers by source

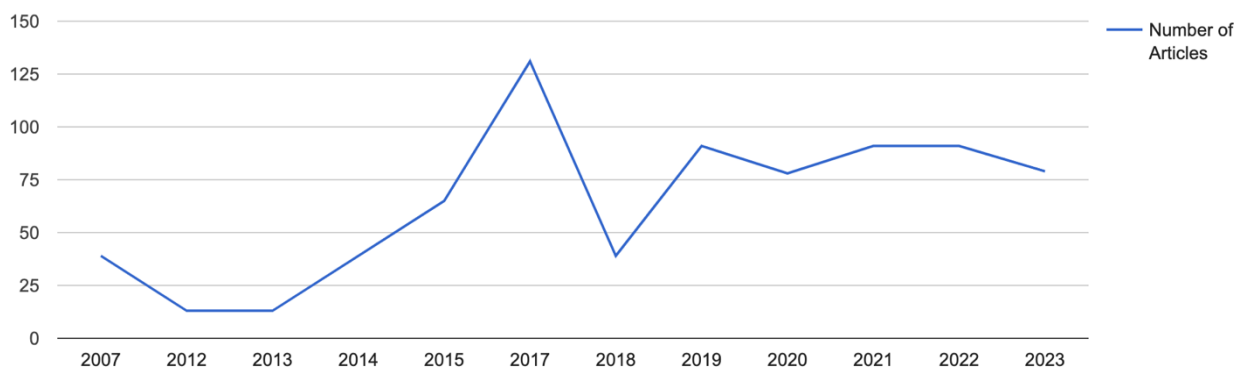


Figure 4. – Distribution of papers per year

From Figure 2 it is possible to see that the source with more papers is Pubmed both when executing the search string and regarding those accepted. From Figure 3 we can see that the highest percentage of acceptance happens with the works of WoS and with those imported from references. Figure 4 shows that most works related with the topic are published in 2017 and there is a constant ratio since 2019.

2.2.2. PRISMA Description

In this section we present the flow analysis of the SLR using PRISMA (*Preferred Reporting Items for Systematic reviews and Meta-Analyses*) protocol [7]. The process is depicted in Figure 5. Initially, 297 papers were imported during the identification phase, which was reduced to 261 after deduplication. During the screening phase, titles, abstracts, and keywords were examined against the inclusion and exclusion criteria, resulting in the exclusion of 205 papers, leaving 56 papers for the eligibility phase. Full reviews of these papers were conducted, and additional papers were discovered by examining bibliographies and systematic reviews. From these, 16 papers were

evaluated similarly to the screening section, yet only 7 were selected for inclusion. Combining these 7 with the initial 56 resulted in 63 papers to be assessed using the quality criteria. Of these, 34 papers achieved a score of 9 or more out of a possible 13 points and were therefore chosen for inclusion in the results section.

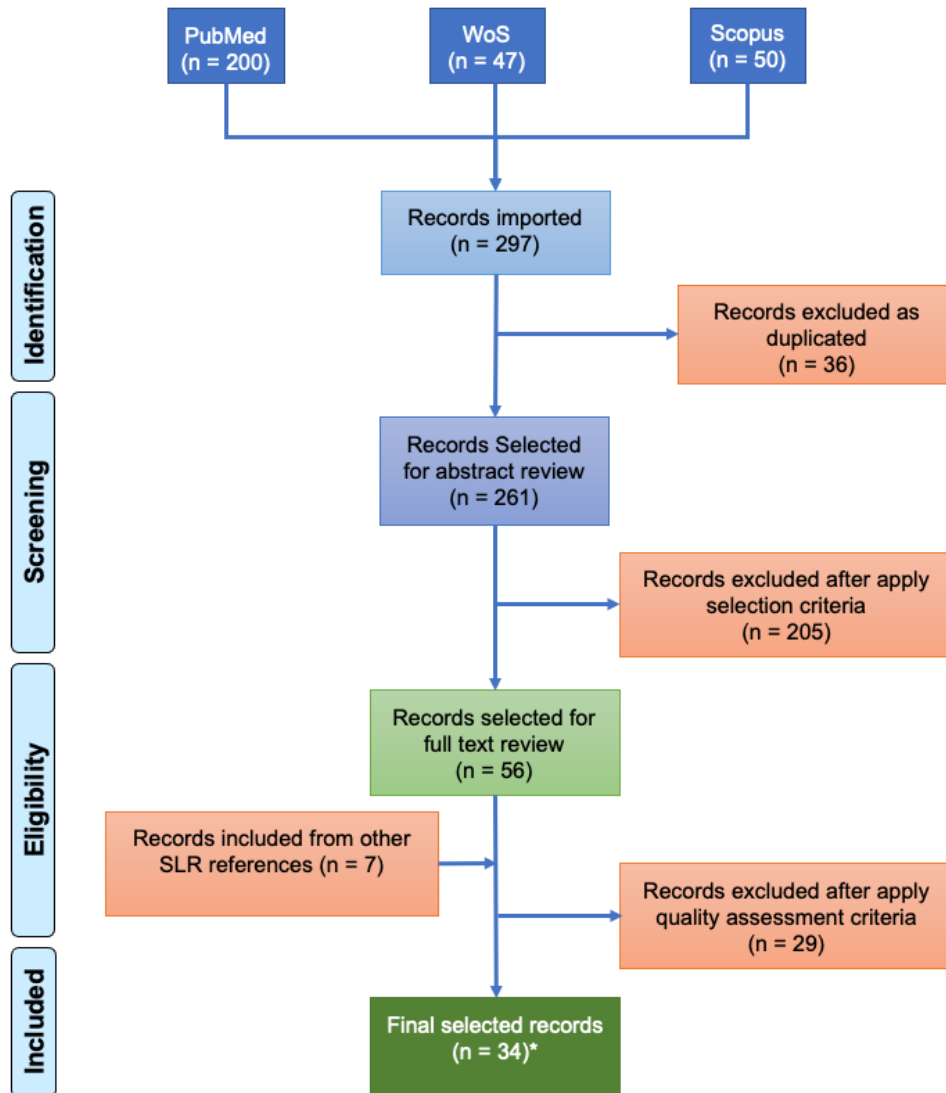


Figure 5. – PRISMA Diagram for the SLR

2.3 Results

Regarding the results first we will present the results for the extraction questions and later we answer the research questions.

2.3.1. Extraction Questions

2.3.1.1. EQ1. Which are the features of the students with IDD?

Table 1. Features

IDD	Reference	Comorbidity
Hearing impairment	[8]	Mental disability [8]
Intellectual disabilities	[9-12] [13-16]	Visual impairment[9]
Mild	[10, 13, 14, 17]	
ASD	[12, 15, 18-22], [23], [24], [25-27] describing different levels [28, 29]	
Mobility	[30]	
Down Syndrome	[15, 31, 32]	
Variety of disabilities	[22, 33-36]	Several of them mixed
Cerebral Palsy	[22, 37-40]	Other brain injury [39]
Learning Difficulty	[41]	

2.3.1.2. EQ2. Which is the technology used for students with IDD?

Table 2. Technology

Technology	Reference
Robotics	[8, 10, 11, 13-18, 20-37, 39-41]
Web Platforms and iPad tablets	[9]
Virtual worlds on large screens, motion sensing technology	[11]
Body-weight support technology	[30]
Game-based therapeutic environments	[19]

2.3.1.3. EQ3. Which are the methodologies used for students with IDD? (If there is any agile methodology please mention and describe how it is adapted))

Table 3. Methodology

Methodologies	Reference
Interacting interfaces with robots	[8, 15, 28, 36, 41]
Self-modeling methodology	[9]
Robots as an assistive technology	[10, 13, 16-18, 20, 23, 27-30, 32, 33, 37, 39, 40]
Bulding robot	[18, 22, 25, 31, 34, 35]

Game-based approach	[11, 19, 25-27]
Video base modelling	[12]
Game environment	[19]
Codding blocks	[14, 21, 22, 26, 31, 34]
Goal Directed Therapy	[40]

2.3.1.4. EQ4. Which characters / behaviours of IDD are likely to respond to technology stimulation?

Table 4. Characters or behaviors

Characteristics/Behavior	Reference
Tactile/kinesthetic feedback	[8]
Cognitive development and autonomy	[10, 12, 21, 22, 28, 35]
Coordinated behavior and rehabilitation	[13, 18]
Operational behaviors, social interaction and emotional responses.	[11, 13, 20, 24-26, 29, 33]
Mobility and physical conditions	[30, 37, 39, 40]
Academic Development	[12, 14, 20, 22, 24, 28, 31-33, 35]
Childrens' emotions	[15, 19]
Specific skills	[16, 27, 41]

2.3.1.5. EQ5. Are they using robotics? Which type?

Table 5. Type of robots

Reference	Robotics	Type
[8, 20, 33]	Yes	Pet robots such as Sony AIBO ERS-7 robotic dog, PARO seal
[9]	No	
[10, 11, 14, 15, 20, 24, 31, 33]	Yes	Mobile robots
[13, 16-18, 20, 23, 25, 26, 28-30, 33, 36, 40]	Yes	Mini humanoid social robot (Robota and GEAR, NAO, iRobiQ, LRS1, ZORA, Pepper, ZECA, Kaspar)
[12, 14, 21, 22, 26, 34, 35]	Yes	Robotics based on block programming and robots based on building blocks.
[19]	Not exactly	Games that could include robots
[37]	Yes	Assistive robotic technology for

		improving mobility - Self-Initiated Prone Progressive Crawler
[41]	Yes	Other

2.3.1.6. EQ6. Which are the improvements in students with IDD learning motivated by the use of the technology? (Attend to the Polloway classification to answer, I have sent it to you by email)

Table 6. Area of Improvement

Improvement Category	Reference
Attention	[8, 13-17, 20, 21, 24, 28, 31-33, 35, 39]
Generalization Learning	[8, 13, 14, 16, 17, 20, 21, 25, 31, 33, 39, 40]
Memory	[8, 13, 16, 24, 41]
Motivational Considerations	[8, 9, 13, 14, 16, 20, 21, 29, 33, 36, 39, 40]
Social-Behavioral Interactions	[8, 11, 13, 15-19, 22, 25-27, 30, 33, 34, 36, 40]
Academic Development	[9, 12-14, 16, 20-23, 25, 27-29, 31-33, 35]
Cognitive Development	[9-15, 17-23, 26, 28, 33-37, 39, 40]
Social Responding	[11, 13, 15, 17, 19, 22-24, 26-28, 30, 34]
Language Development	[13, 22, 26, 32, 41]

2.3.1.7. EQ7. Describe the improvement in students with IDD learning

Table 7. Specific improvement

Reference	Improvement
[8]	Attention and usability.
[9, 35, 39]	Increase in students' motivation while improving their understanding of the tasks they had to perform and their acquisition of knowledge.
[10, 29, 31]	Understanding and focus on specific materials.
[18, 20, 22, 23, 25, 26, 28, 29, 36]	Social interaction skills and communicative competence.
[11]	Elicits operational behaviors, social interaction and emotional responses that normally do not occur using other methods, or that require a much longer time to be achieved.
[30]	Engage children into motor activity through social interaction.
[12, 14, 21, 22, 31, 34]	Developing coding skills
[19]	Helped in developing the children's emotional expressions
[13]	Study of the use of robots for students with IDD
[17, 22]	Enhanced students' attention and improved feedback experience.
[33]	Improved attention and interest in the school environment
[32]	Improvement of participants' English vocabulary learning and short-term verbal memory.
[15]	Interacting with Cozmo resulted in positive affect, high engagement and collaboration
[16]	Reduce time to complete task and errors and increase episodic memory

[37, 39, 40]	Improve physical mobility, gross motor development and related cognitive ability
[41]	Memory and Language skills

2.3.2. Answers to the research questions

In order to summarize the findings obtained during the SLR in this section we will try to answer each of the defined research questions.

2.3.2.1. How can educational robotics and active learning methodologies support intellectual and developmental IDD students in STEAM Education?

Education robots and active learning methodologies can be a proper solution to enhance learning for regular students and are applied in several educational activities [42-45]. However when dealing with disabled students and in disciplines such as STEAM it is not always possible to give the same answer [46]. In this situation specially robotics are used in STEAM education as shown in section Table 2 and they can be use in several ways (Table 3): as an assistive technology to help or motivate students during the classes [10, 13, 16-18, 20, 23, 27-30, 32, 33, 37, 39, 40], as a way to interact with this type of entities [8, 15, 28, 36, 41], as a tool to gain specific skills required by disabled students such as cognitive development [10, 12, 21, 22, 28, 35] or social skills [11, 13, 20, 24-26, 29, 33], or to improve some of the STEAM related ones as can be coding [14, 21, 22, 26, 31, 34] or problem solving as building a robot [18, 22, 25, 31, 34, 35]. Active learning methodologies are not so common in this field, problem solving is mentioned and also game-based approaches [11, 19, 25-27], the other methodologies are very specific and adapted for the disabled students (Table 3).

If we focus in the question in the technology robotics is the most relevant one and it is employed in a tangential way in some works as shown in Table 2. Regarding the type of robotics this is (summarized in table 5) it is possible to see that the most common is to use humanoids robots [13, 16-18, 20, 23, 25, 26, 28-30, 33, 36, 40] something normal if the most common to employ it to assist learning and pet robots in case of younger children [8, 20, 33]. However, we should also point out the use of robots based on building blocks to enhance both coding and engineering activities [12, 14, 21, 22, 26, 34, 35] and also the use mobile robots in navigational problems [10, 11, 14, 15, 20, 24, 31, 33] or the enhance mobility skills of the disabled students.

2.3.2.2. What are the features of user model of a IDD person?

The features of the users are conditioned by the disabilities and the levels because this condition the adaptations to do and the possible educational activities to develop. For instance, it is not always possible to use the same activities and resources with ASD level 1 students than with ASD level 3 students. This means that it is necessary to be able to classify the users and disabilities, for which it can be useful the use of guides such as [47].

However, the educational activities include other elements to consider. In fact, in the field of STEAM education and using Robotics and/or active learning there is an important variety of features. Table 1 summarize some of them. Most of the works deals with ASD [12, 15, 18-29] students although, there is also an important number under the category of cerebral palsy [22, 37-40]. It is also necessary to point out that generic categories such as “intellectual disabilities” [9-17] or those works covering several of them have an important representation [22, 33-36].

If we consider the features and behaviours addressed Table 4 the most common feature is to facilitate academic development [12, 14, 20, 22, 24, 28, 31-33, 35], improve operational behaviours, social interaction and emotional responses [11, 13, 20, 24-26, 29, 33], and enhance cognitive development and autonomy [10, 12, 21, 22, 28, 35]. Of course there are other features related with other disabilities.

This means that it is not easy to make general assumptions for a specific disability, for a level or even for a person which implies the need to define a taxonomy that help the teachers to categorize the whole educational activity to carry out, and with it to build the proper learning plan for each student.

2.3.2.3. How does the customization level of technologies impact the learning outcomes and engagement of students with IDD in the field of STEAM Education?

In any of the selected papers for the study an adaption must be done for the students with disabilities, something related with the specific needs IDD students. The impact on learning outcomes depends on the objectives defined for each learning activity, that should be defined by the students features. Table 4 and Table 7 describe specific improvements. The most related with educational activities can be: Academic Development [12, 14, 20, 22, 24, 28, 31-33, 35], specific skill development [16, 27, 41] and cognition and autonomy [10, 12, 21, 22, 28, 35]. Regarding specific difficulties, some are related with improvements in their interactions with their peers and the environment [11, 13, 20, 24-26, 29, 33], other with emotions understanding and regulation [15,

19], and other related with their mobility and improvement of their physical condition [30, 37, 39, 40]. Table 7 summarize the specific goal of each technology application.

In order to follow a proper categorization we have used Polloway classification [48] distinguishing the improvement impact area into: attention, metacognition, memory, generalization learning, motivational considerations, cognitive development, language development, academic development, social-behavioral interaction, and social responding. That are well known in the IDD field (Table 6). Each work could address several of the areas with the intervention, distribution of works into the metioned areas can be seen in Figure 6. It is possible to see that Cognitive and Academic Development are the most significant categories, which means that the robots and active methodologies look for improve students' performance and other such as Social Behavior, Social responding or Attention are also very representative and linked to the specific students' needs. It is necessary to point out that the language and memory development are not the goal of the interventions for the selected papers.

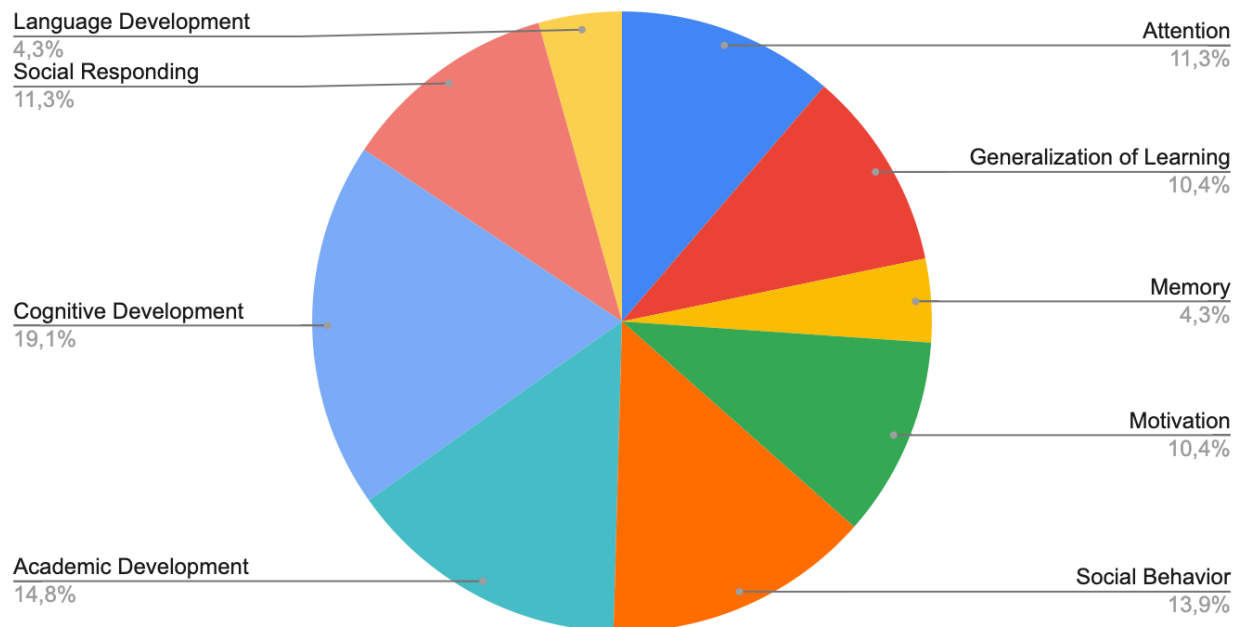


Figure 6. Distribution of works by Polloway categories.

2.3.2.4. What are the specific social and communication skill improvements observed in STEAM students with IDD when engaging with socially interactive robots/ technologies?

For several disabilities such as ASD, Cerebral Palsy or Down Syndrome an important difficulty is social behaviours and communication skills. The use of robots can be a proper solution for this. In fact tables 4,6 and 7 show the relevance among the selected works, the robots facilitate students interactions, help them to understand how to behave and how to communicate with others. In the case of the categories proposed by Polloway there are 2 main areas that explore this Social Behavioral Interaction and Social Responding. The former is related with to promote social competence, reinforce appropriate behaviour, understand why those are proper behaviors and learning self-control and self management. The later is related to social perception, roles at class, avoid social manipulation, etc. If we consider both of them together they mean about a 25% of the selected contributions so it is a specially important focus.

Regarding Social-Behaviorial interactions robotics can be really interesting as they help students in recognizing and understanding emotions and improving relationships, such as the works: [11, 13, 15, 19, 20, 24-26, 29, 33]. In addition robots can support for IDD students social interactions, specially social and humanoid robots can simulate these interactions and help students to reassure their behaviors and to understand how to interact [13, 16-18, 20, 23, 25, 26, 28-30, 33, 36, 40].

Regarding Social responding active methodologies such as project or problem based learning would involve the students into groups and help them with understanding roles, especially if they work in a controlled environment. Also robots simulating different interacting scenarios would help on this [11, 13, 16-20, 23, 25, 26, 28-30, 33, 36, 40].

3. Compilation of experts knowledge

The systematic literature review (SLR) offers us an overview of the research discussed in academic literature relevant to our current study. However, it is also crucial to understand how each school involved in the project addresses IDD and their students' needs. To facilitate this, a template (referenced as Figure 2) has been created and disseminated amongst the consortium members.

Project-No.:2023-1-ES01-KA220-SCH-000155379-("ROBOSTEAMSEN")

1. → Personal information of the respondent

[In this section the respondent should fill some information]

- → Centre: [in which you work or with which you collaborate]
- → Professional profile: [teacher/researcher/assistant/doctor/medical/carer]
- → Describe your expertise with people with IDD:
- → Years of expertise:
- → How would you rate your experience in the use of technology: [use a scale from 0-10]
- → Do you teach students with IDD:
- → If previous answer was yes in which educational level:
- → Describe how people with IDD is integrated in your institution [completely integrated in regular classes/regular classes and extra work/ different classes/ N/A]
- → Do you have any expert support to use the technology to develop your classes with students with IDD?

2. → Most common IDD you have deal with

[Describe in a list the 10 most common IDD you have deal with, it should be ordered from the most common to the least common]

3. → Describe an IDD

[Describe an IDD considering the following issues. Please avoid IDD repetition if possible, in your institution and in other]:

- → Name:
- → Brief description:
- → Main features of the affected student taking into account severity levels:
- → Main problems at class:
- → Adaptions required for this type of student:
- → How you evaluate the activities of these students:
- → What do you recommend to do to deal with the student and what not:
- → Technological solution used by you or that you know can be applied to improve their learning (if any):

4. → Possible intervention

[Describe a possible intervention to deal with this student at class and if it would be portable to other schools or contexts]



Figure 7. – Template for gathering the expertise of the respondents

The answers to this templates are commented in the below subsections and can be found at:

https://drive.google.com/drive/folders/1Up_3b8H0xGuJfL3Xxx0oXjO0hzXK1_5w?usp=drive_link

3.1. Information of the respondents

In this section aggregated in an annomyzed way the answers of the centres about the different questions about the teachers involved. We should point out that the same teachers could fulfil the template more than once, because the most interesting part of the template is the description of an IDD. We had a total of 44 templates fulfilled answered by 26 workers of the schools. The answers are shown following the templated provided to the schools:

- Professional profile: [teacher/researcher/assistant/doctor/medical/carer]. Regarding this question for SCO and CIC all the participants were teachers, for EuroEd about a 66% of the respondents and for UEF the 80%. This means that 80,76% of the participants were teachers and the rest researchers.
- Describe your expertise with people with IDD. The answers about the expertise of the people involved were quite heterogeneous. Some of the answers were related to their concrete experiences with students with IDD describing the contexts of such experience while other describe their background. In this sense the teachers from SCO and 3 of the respondents from EuroED have a specific background of SEN teaching, something similar happens with 2 teachers from UEF.
- Years of expertise and use of technology. The average number of working years of the respondents can be seen in Figure 8 and how they rate their use of technology, this is grouped by institutions. It is possible to see that the years of expertise are higher in SCO and CIC and the use of technology in EuroEd, something probably related with the age of the participants. In any case average numbers are quite remarkable with an expertise of more than 10 years and rates higher than 6,45.

Years & Technology expertise

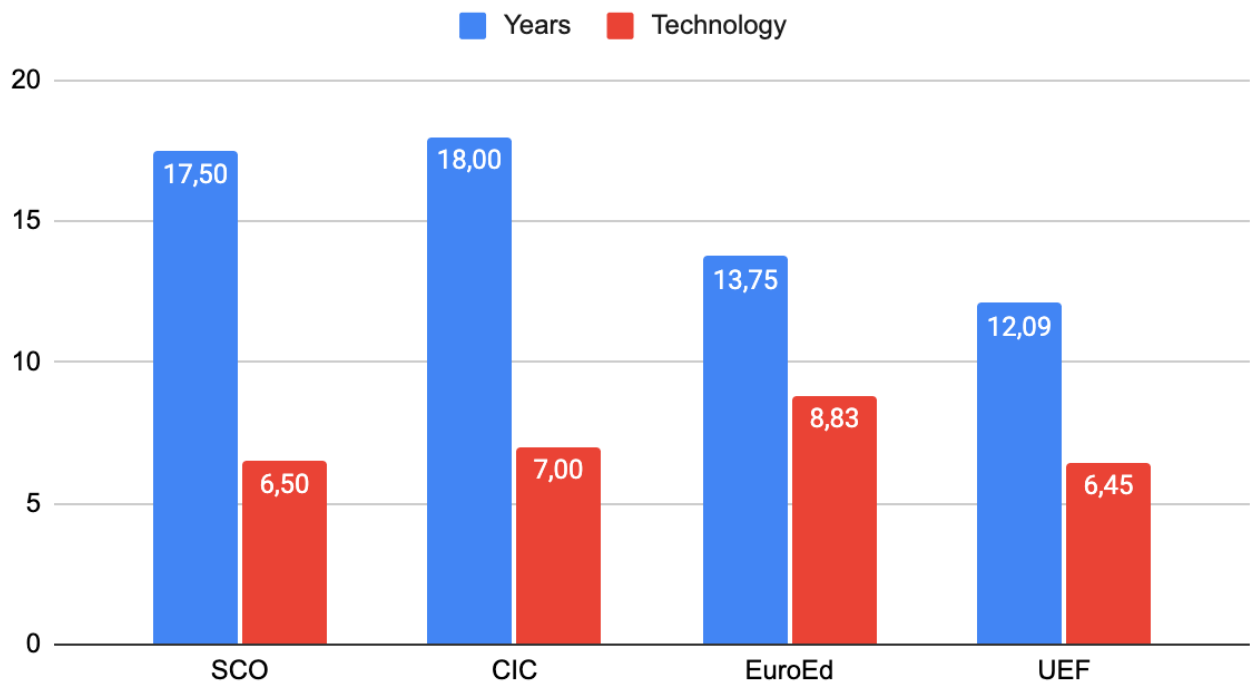


Figure 8. Years of expertise and perception of use of technology

- Do you teach students with IDD: In SCO and CIC the 100% of participants are teaching students with IDD, while in EuroEd a 91,66% and in UEF a 90% are currently working with them.
- If previous answer was yes in which educational level. In this means several educational levels are considered. SCO is an SEN Institution so they include some specific levels: Compulsory Basic Education (EBO) and transition to adult life (TVA). Regarding CIC they are focused on secondary education. In EuroEd they deal with students with IDD in kindergarden, primary and secondary school. In UEF they consider pre-school courses, primary and secondary education. This means the school education is completely covered through the institutions involved.
- Describe how people with IDD is integrated in your institution. This depend on the school for SCO, as a SEN institution, all the classes will be specially defined for the students' needs, in fact they based their integration strategy in five pillars: individualized programs, curriculum adaptations, support from specialists, social inclusion, physical and technological accessibility. In UEF most of students are integrated in regular classes but those with severe

IDD levels only integrated in some of them. The rests of schools fully integrate IDD students into regular classes although in some cases they could need some extra work.

- Expert support to use the technology. In the case of SCO and CIC they have not support and they develop their own training with technology. In EuroEd there is an expert who supports the teachers. In UEF they have in most cases support by an expert.

3.2. Most common IDD

In this case the participants on the survey answered with the list of IDDs that they have commonly work with. We have considered one answer per template, each answer could include a list up to 10 disabilities. The distribution is shown in Figure 9. In this figure it is clear that ASD, ADHD, Down Syndrome and Dislexya disabilities are the most common ones.

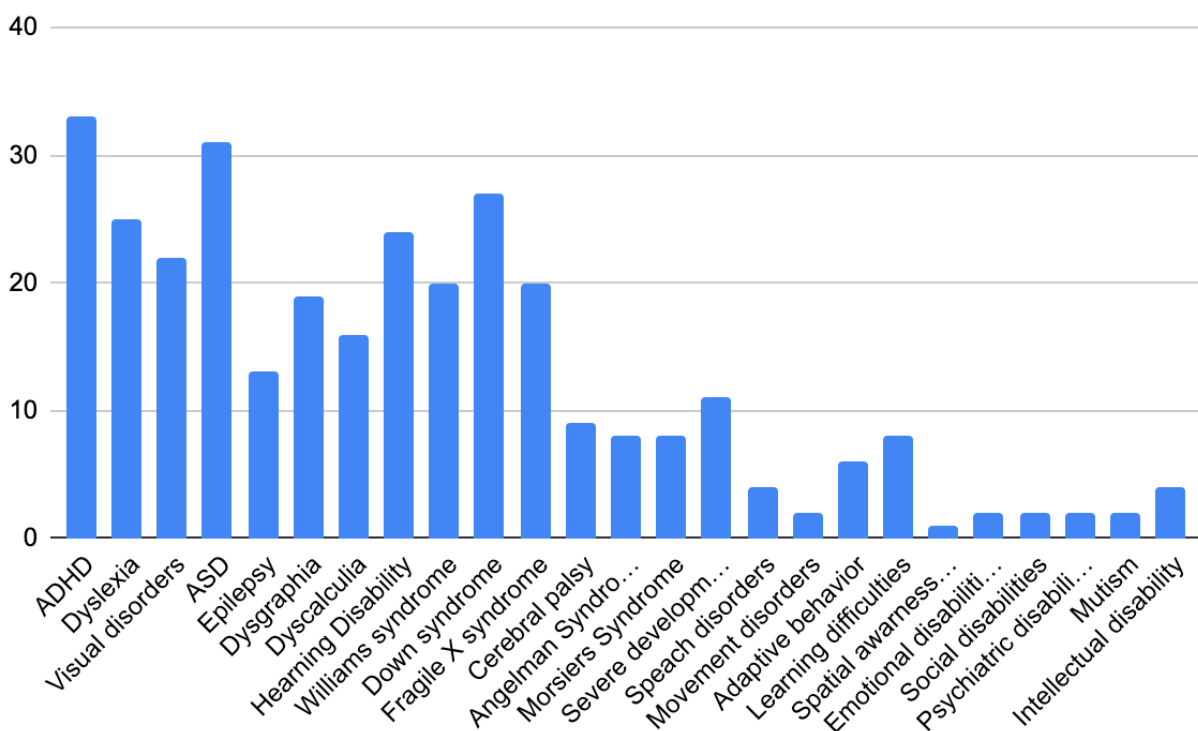


Figure 9. – Distribution of IDDs the participants have worked with

3.3. Described IDDs

This section describes an IDD and how it is addressed by each teacher in each institution. The answers should follow the template, which means to consider:

- Name
- Brief description

- Main features of the affected student taking into account severity levels
- Main problems at class
- Adaptions required for this type of student
- How you evaluate the activities of these students
- What do you recommend to do to deal with the student and what not
- Technological solution used by you or that you know can be applied to improve their learning (if any).

All responses are accessible in the directory; however, this section will highlight the most frequently noted IDD, feature a tag cloud summarizing the IDD descriptions, and provide a table summarizing the responses. This section omits detailed descriptions, characteristics, and medical or therapeutic recommendations to enhance the report's readability and because they are not critical to the conducted research.

3.3.1 Most described IDD

Regarding the described IDD from the 44 fulfilled templates we achieved 21 that are distributed in the disabilities presented by Figure 10. It is clear from it that the most relevant IDDs were ASD, Hearning Disabilities, ADHD and Intellectual Disabilities (general term).

Number of IDD descriptions

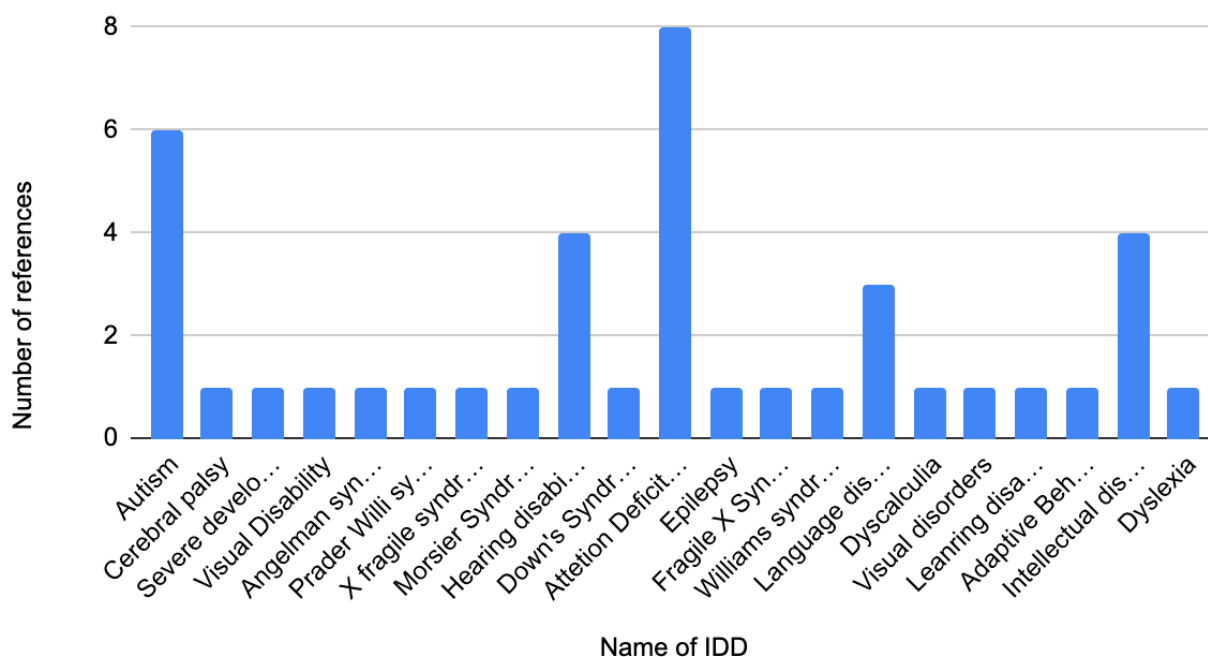


Figure 10. – IDD Described by the survey. Participants

3.3.2 Descriptions summary

Although it is possible to summarize the description of the IDD's and how they are addressed in the different institutions. In this sense we try to summarize it with a tagcloud and a table. The tagcloud is based on a document with 19106 words, excluding prepositions, articles and other void terms.

The result can be seen in Figure 11. In the tagcloud it is possible to see the student as the centre of the discussion, including terms related to the difficulties associated to some IDD's such as “visual”, “social”, “hearing”, to the IDD itself such as “need”, “problem”, “syndrome”; others related to the educational processes such as “skills”, “learning”, “work”, “activities”, “classroom”, “assessment”, “help” or “tasks”. This makes clear that student have different difficulties in the educational environment.



Figure 11. – Tagcloud with the IDD descriptions

In order to summarize the results of the templates we have defined a table (Table 2) with the information of each IDD. In some cases, we distinguish between IDD levels as they have different ways to proceed with students. The table includes 8 columns, the first one describes the main problems at class of students with IDD, the second the adaptations required, the third considers how the students work is assessed, the fourth considers recommendations and the last one possible technological solutions used with them.

Table 8. – Summary of IDD descriptions

IDD	Main problems at class	Adaptions	Evaluation	Suggestions	Technology
Prader Willi Syndrome	- Perseverance or obsessive thinking - Weak control of emotions. - Foraging.	- Attention and memory. - Language and reasoning. - Psychomotor	Formative assessment, systematic observation, using tests, etc.	- Visual aids - Avoid word no	- Interactive apps and educational games - Tablets and touch devices - Adaptive platforms

IDD	Main problems at class	Adaptions	Evaluation	Suggestions	Technology
	- Self-harm.	skills. - Sociability and behavior.			- Accessible devices
ASD Level 3	- Needs totally individualized attention and calm and predictable environment. - Needs time to be on your own between activities - Needs clear gestural or visual commands and anticipation. - Speech therapy, music and physical education. - Needs transportation	- To extend the waiting times little by little. - Anticipate with photos, pics or real objects. - Develop the basic learning strategies - Needs prior demonstration. - Needs significant adaptations in content related to: language, social skills, alternative communication system, etc.	Formative assessment, systematic observation, using tests, etc.	- Follow some daily routines - Specific activities	- Alternative communication systems. - Interactive Apps and Educational Games. - Tablets and touch devices. - Multisensory learning tools. - Customized educational platforms. - Access devices. - Augmented reality in sensory activities.
Cerebral Palsy (quadriplegic form)	- Physical accessibility. - Lack of resources and adaptive technology. - Social Isolation. - Communication problems. - Challenges in academic activities. - Personal assistance requirements. - Challenges in mobility and transportation. - Institutional lack of awareness and training. - Limitations in physical and sports activities. - Emotional and psicological challenges.	- Physical accessibility - Provide adaptive technology - Support in academic activities - Personal assistance - Social participation - Provide training in the use of assisted communication devices - Emotional and psychosocial support - Transportation planning	Formative assessment, systematic observation, using tests, etc.	- Know specific needs - Collaborate with professionals - Encourage open communication - Adapt the environment - Incorporate assistive technology - Promote inclusion	- Augmentative and Alternative Communication Systems and Devices. - Virtual Reality (VR) and Augmented Reality (AR) - Environmental Control Systems
Fragile X Syndrome	- Saw - Heard - Smell - Tact - Taste	- Cognitive needs - Personal or affective needs - Interpersonal relationship and social adaptation needs - Psychomotor development - Communicative-linguistic needs	Formative assessment, systematic observation, using tests, etc.	- Focus on the priorities - Avoid Harsh Lighting - Reduce unnecessary noises - Speak calmly and confidently - Use gentle massages - Avoid demanding eye	- Interactive Apps and Educational Games - Tablets and touch devices - Customized educational platforms - Access devices - Activities based on the assembly of programmable electronic circuits

IDD	Main problems at class	Adaptions	Evaluation	Suggestions	Technology
				contact - Avoid forcing Texture Touch	
Visual Disability (total or partial)	Heterogeneous based on: - Severity - Degree of functionality of the visual rest. - Comorbidity. - The moment of appearance of the visual deficiency - Sudden or gradual. - The etiology of visual disorder and its prognosis	- Teaching team must know the management and know how to use the adaptations - Order and location of the different elements of the classroom and the center must be respected - Sit in the front row in front of the blackboard - Time adaption or tasks reduction - Adapted printed contents	- Formative assessment, systematic observation, using tests, etc. - Use oral evaluation - Use evaluation through oral procedures if necessary - Use expanded exams for low vision students - Transcription of the exams into braille code. - Carrying out evaluations on Perkins machine - Granting more time to take exams - Grant less specific weight to those components of visual content	- Follow some daily routine objectives - Develop your visual ability if the child has visual remains - Stimulate the rest of the senses - Encourage symbolic play - Promote group work - Have qualified teachers in visual disabilities	- Notators, Braille Lines and Printers Technical help - Audio books. - Stories from the SBOTechnical help - Braille and relief writing Technical aids - Games and sports Technical aids - Electronic magnifying glasses Technical aids - Clocks, alarm clocks and time meters Technical aids - The assembly of programmable electronic circuits has shown the student's interest, posing as a challenge the elaboration of programs that perform simple tasks.
Angelman Syndrome	- Dispersed attention and difficulties in maintaining it. - Perception and discrimination of the relevant aspects that have to be learned. - Information retention. - Symbolization and abstraction. - Strategies to learn to plan. - Generalization of learning - Behavioral problems	- Information provided must be simple, concrete, precise, - Information in different formats to facilitate the student's perception of it in as many ways as possible - Group tasks should be short - Tasks must be frequently modified - Positive reinforcement strategies	Formative assessment, systematic observation, using tests, etc.	- Need the help of different types of professionals - Learning through structured play - Need to learn to communicate in natural and functional contexts - Clear, simple language, and speak slowly	- Alternative communication systems. - Interactive Apps and Educational Games. - Tablets and touch devices. - Multisensory learning tools. - Customized educational platforms. - Access devices. - Augmented reality in sensory activities.
Hearing disabilities with Co-clear implant	Depending on the severity level they could show problems as: - Accessing contents - Hearing what the teachers says - Self-Esteem and	- Assistive Technology - Acoustic Environment - Positioning in the Classroom - Support from a Sign Language Interpreter	- Language Development Assessment - Auditory Skills Assessment - Academic Performance Monitoring: - Assessment of	- Assistive Technology - Strategic Classroom Location - Adaptations in Communication - Adaptations in Assessments	- Simulation Games - Awareness Games - Multimedia Resources - Oral Expression Games - Hearing Memory Games - Activities based on

IDD	Main problems at class	Adaptions	Evaluation	Suggestions	Technology
	Confidence - Problems to put write their ideas down on paper	- Adaptations in Didactic Materials - Clear and Visual Communication - Additional Time for Tasks and Assessments - Collaboration with Health - Professionals for personalizing Education Program - Education in Auditory Consciousness - Adaptations in Social and Recreational Activities	Verbal Understanding - Evaluation of Communication Strategies - Assessment of the Learning Environment	- Encourage Self-Esteem and Confidence - Promotion of Autonomy - Ask experts - Provide positive feedback	the assembly of programmable electronic circuits - Bookwidgets or Wordwall, which help ordering the sentences in a paragraph or unjumble the sentences in a coherent text - Assistive Hearing Devices
Morsier syndrome	Requires individualized education focused on experiential learning	- Individualized assessment - Classroom modifications - Communication support - Adaptations in educational materials - Motor and physical support - Participate in individualized education program	- Initial Assessment - Cognitive Developmental Assessment - Motor Skills Assessment - Assessment of Sensory Skills - Communication Skills Assessment - Classroom Observation - Social Emotional Assessment - Ongoing Monitoring	- Individualized Assessment - Collaboration with Health Professionals - Development of an Individualized Education Program - Adaptations in the Educational Environment - Use of Assistive Technology - Communication Skills Support - Focus on Experiential Learning - Social Inclusion	- Augmentative and alternative communication - Interactive Storytelling - Games - Multisensory learning tools.
Down Syndrome	Depending on the severity they can present difficulties about: - Autonomy - Social Skills problems - Cognitive Skills - Motricity - Language	Apply specific programs of personal autonomy, training in social skills and emotional education, aimed at promoting their independence. Tailor individual curricular adaptations	Formative assessment, systematic observation, using tests, etc.	- Enhance their autonomy. - Error-free learning. - Improve their social skills. - Work on their verbal expression. - Motricity. - Establish routines in the classroom. - Positively reinforce the small and large achievements you make. - Place the student	- Activities based on the assembly of programmable electronic circuits

IDD	Main problems at class	Adaptions	Evaluation	Suggestions	Technology
				close to the teacher to support them when required, but promoting autonomous work.	
Severe developmental delay and cerebral motor disorder associated with hypotonia and ataxia pattern		- Identification of the educational needs of students with cerebral palsy to the design of the intervention and its implementation - Materials for the diagnosis of the needs and a selection of technical aids for the intervention	Formative assessment, systematic observation, using tests, etc.	- Keep the aisles clear - Check necessary adjustments and correct them in case they don't work - Give students more time to complete activities - Have a plan for when a student with cerebral palsy has to skip classes, assignments, or tests. - Talk about differences in class and celebrate them.	Specific tables, systems that allow the attachment of a computer to a wheelchair, alternative ways to attract attention to the classic "raise your hand" of the rest of the classmates, keyboards of programmable concepts for specific learning, etc
ADHD	- Social communication - Interaction of the students with the pairs - Overlook or miss details and make seemingly careless mistakes in schoolwork, at work, or during other activities - Hard to follow through on instructions or finish schoolwork, chores, or duties in the workplace - Difficulty sustaining attention during play or tasks, such as conversations, lectures, or lengthy reading. - Disciplinary control of the class, creating difficulties in teaching very expository topics	- Working on the relationship with peers - Teaching subjects in a more direct way and allowing student participation and involvement in the subjects to be covered - Pre- plans for everything, tell what happens - Classes with greater practical activity usually allow for good results. - Tailored assistance through the use of various digital tools and apps - Give the student rewards for acting in a desired way, such as controlling anger or thinking before acting - Give student additional breaks or specially	In class, the student is asked to participate in answering simple questions and tasks. The theoretical assessment is carried out on the basis of written tests with simple and direct questions. Practical assessment is based on the completion of guided and straightforward tasks. - Through the conversation method, making eye contact with the student to help them focus and capture their attention. - Through worksheets on which they work individually, at their own pace.	- The student must deal with well-described and directly oriented tasks. - Avoid the use of elaborate and complex methodologies. - Keep the student further ahead in the classroom - Ask students more direct questions - Propose simpler reading texts - Provide them with more time to complete the tasks - Keeping a routine and a schedule. - Using homework and notebook organizers. - Lots of positive feedback and ignoring things that go wrong. Trying to built the activities and environment as	- Assistive technology - The assembly of programmable electronic circuits has shown the student's interest, posing as a challenge the elaboration of programs that perform simple tasks - The use of educational platforms, with interactive content to attract the student's attention. - Drilling on computers seems to be effective. Tools to show the structure of the lesson/day, timers, feedback tools - Classroom screen and other technology to make the class more attractive.

IDD	Main problems at class	Adaptions	Evaluation	Suggestions	Technology
		designed moments for movements - Short and personal instructions, tools to cut out noise and visual distractions	- The evaluation of knowledge and skills is a standard one, but the feedback provided is personalized. - Attending only to learning goals and not behavior	functional for them as possible. - Get them suitable help as early as possible and get extra help in classroom to better deal with these kind of students. Every case is bit of different, so if something worked previously, it may not work that well again. - Chill atmosphere and lots of humor.	
ASD Mild and moderate levels	- Social communication - Interaction of the students with pairs - Sudden movements and noises (throwing things or lying down and screaming) that distract the other children - ASD students show little empathy and avoid making eye contact	- Working on the relationship with peers - Adequacy of curricular accommodations, being able to carry out non-significant curricular adaptations or significant curricular adaptations. - Instruct the other children about the issue and help them understand what is happening. - Positive Reinforcements	- In class, answering simple questions and tasks. - Theoretical contents by written tests with simple and direct questions. - Practical assessment is based on the completion of guided and straightforward tasks. - The students can be according to various specific skills (hygiene, social, behaviour, academic) - Continuous evaluation, short tests, oral exams	- Well-described and directly oriented tasks, avoiding the use of elaborate and complex methodologies. - Patience and following a specialised training guide/steps bring forward results. - Be warm, empathic but strict. Try to find and use the students interests but also teach them to tolerate unpleasant things too.	- The assembly of programmable electronic circuits has shown the student's interest, posing as a challenge the elaboration of programs that perform simple tasks - Computers can focus their attention - Microsoft 365 Word: Immersive Reader, Ekapeli (Finnish learning game for reading), audio books.
Epilepsy	- Social communication - Interaction of the students with pairs	- Working on the relationship with peers - Adapt the size of the PC screen - Avoid strong light variations - Adapt the colors of the given materials.	- In class, answering simple questions and tasks. - Theoretical contents by written tests with simple and direct questions. - Practical assessment is based on the completion of guided and straightforward	- Avoid strong light variations - Adapt the colors of the given materials.	The assembly of programmable electronic circuits has shown the student's interest, posing as a challenge the elaboration of programs that perform simple tasks

IDD	Main problems at class	Adaptions	Evaluation	Suggestions	Technology
			tasks.		
Dyslexia	- Social communication - Interaction of the students with pairs - Difficulties to understand instructions, learning content, text you are reading	- Working on the relationship with peers - Ask more direct questions - Propose simpler reading texts - Provide more time available to the student to complete their tasks - Adapt the given materials with direct instructions - Do not penalize spelling mistakes. - Individual guidance, materials, support	- In class, answering simple questions and tasks. - Theoretical contents by written tests with simple and direct questions. - Practical assessment is based on the completion of guided and straightforward tasks. - Observing and asking teacher and student.	- Well-described and directly oriented tasks, avoiding the use of elaborate and complex methodologies. - Personalization of learning and expert support	The assembly of programmable electronic circuits has shown the student's interest, posing as a challenge the elaboration of programs that perform simple tasks - Digital materials of book series, Ville, Qridi and Seesaw, Immersive reading (Word), Celia (audiobooks)
Dysgraphia	- Social communication - Interaction of the students with pairs	- Working on the relationship with peers - Ask more direct questions - Propose simpler reading texts - Provide more time available to the student to complete their tasks - Adapt the given materials with direct instructions - Do not penalize spelling mistakes. - Allow rewriting of documents	- In class, answering simple questions and tasks. - Theoretical contents by written tests with simple and direct questions. - Practical assessment is based on the completion of guided and straightforward tasks.	- Well-described and directly oriented tasks, avoiding the use of elaborate and complex methodologies.	The assembly of programmable electronic circuits has shown the student's interest, posing as a challenge the elaboration of programs that perform simple tasks
Dyscalculia	- Social communication - Interaction of the students with pairs	- Working on the relationship with peers - Ask more direct questions - Propose simpler reading texts - Provide more time available to the student to complete their tasks - Adapt the given materials with direct instructions - Do not penalize number mistakes	- In class, answering simple questions and tasks. - Theoretical contents by written tests with simple and direct questions. - Practical assessment is based on the completion of guided and straightforward tasks.	- Well-described and directly oriented tasks, avoiding the use of elaborate and complex methodologies.	The assembly of programmable electronic circuits has shown the student's interest, posing as a challenge the elaboration of programs that perform simple tasks
Color blindness or color vision deficiency	- Social communication - Interaction of the	- Working on the relationship with peers	- In class, answering simple questions and	- Well-described and directly oriented tasks,	The assembly of programmable electronic circuits has

IDD	Main problems at class	Adaptions	Evaluation	Suggestions	Technology
	students with pairs	- Provide more time available to the student to complete their tasks - Adapt the colors of the given materials	tasks. - Theoretical contents by written tests with simple and direct questions. - Practical assessment is based on the completion of guided and straightforward tasks.	avoiding the use of elaborate and complex methodologies.	shown the student's interest, posing as a challenge the elaboration of programs that perform simple tasks
Williams syndrome	- Social communication - Interaction of the students with pairs	- Working on the relationship with peers - Adequacy of curricular accommodations, being able to carry out non-significant curricular adaptations or significant curricular adaptations	- In class, answering simple questions and tasks. - Theoretical contents by written tests with simple and direct questions. - Practical assessment is based on the completion of guided and straightforward tasks.	- Well-described and directly oriented tasks, avoiding the use of elaborate and complex methodologies. - Keep the student further ahead in the classroom, ask more direct questions and make more time available to the student	The assembly of programmable electronic circuits has shown the student's interest, posing as a challenge the elaboration of programs that perform simple tasks
Adaptive Behavior	- Attention of all colleagues fall on the child in discussion - All the teacher's energy goes to calm down the child in need - Problems with artistic and literacy skills	- Special teacher for the student in need or special training for the teacher to handle the student	- Depending on his/hers IQ level, adapted level different from the class.	- Talk to the student about what is correct to be done, about feelings both his/hers and the colleagues', about activities to learn new things or consolidate the old ones. - Do not scream or punish the child, do not push him away from the rest of the class and do not let him behind	- Use of worksheet websites or dedicated sites where the teacher makes her own worksheets according to the needs of her special students. - Movie makers or YouTube channel
Language problems	- Struggled to be understood so he avoided speaking - They feel ashamed about how they speak	- Create friendly atmosphere in his class/ school and made sure he had the best communicative environment - Individualised therapy programme & assisted the process of recovery	- Assessed his speech, language and communication skills	- Support from experts - Avoid situations in which the student can feel ashamed.	Digital tools
Intellectual	- Lack of focus on	- Differentiated	- Personal		- Visualization of

IDD	Main problems at class	Adaptions	Evaluation	Suggestions	Technology
Disability	Learning. - Concentration, remembering new things, learning in general - Keeping up with teaching and following the instructions	instructions and exercises for their abilities. - Lowering their targets and adapting teaching to their personal level	evaluation - Continuous evaluation of how these students work and learn, short tests, oral exams, try to use students interests so they can show what they have learned		teaching, application with ipad - Ville, Ekapeli, Classroomscreen.com, timers

3.3.3 Interventions

In this section we present a summary of the interventions for the described IDD (Table 9). It is necessary to point out that not all the IDDs have associated described interventions and that some of them can be used for several IDDs.

Table 9. – Summary of interventions for the IDDs

IDD	Possible Interventions
Prader-Willi syndrome	- Implement adaptive applications and software that focus on the specific needs of the student. For example, augmentative and alternative communication (AAC) apps, interactive educational games, and progress tracking tools. - Imitation and modeling with the help of an interactive robot. - Use touch devices and tablets with software designed for intuitive interaction and adapted to the student's motor skills. - Create an accessible virtual environment that incorporates visual, auditory and tactile elements to facilitate student understanding. - Use online learning platforms that allow customization of content according to individual needs.
Severe ASD	- Implement adaptive applications and software that focus on the specific needs of the student. For example, augmentative and alternative communication (AAC) apps, interactive educational games, and progress tracking tools. - Imitation and modeling with the help of an interactive robot. - Use touch devices and tablets with software designed for intuitive interaction and adapted to the student's motor skills. - Create an accessible virtual environment that incorporates visual, auditory and tactile elements to facilitate student understanding. - Use online learning platforms that allow customization of content according to individual needs.
Cerebral palsy in quadriplegic form	- Communication: • Implement an augmentative and alternative communication (AAC) device, such as a tablet with a specialized application, to facilitate student expression and communication. • Customize AAC to fit the student's specific motor skills. - Access to Information and Learning: • Use adaptive computer control technologies, such as eye-tracking devices or switches, to allow the student to access information on computers and electronic devices. • Incorporate educational applications designed for students with disabilities, with adapted content and accessible interaction options. - Mobility and Physical Participation: • Explore the use of exoskeletons or assisted mobility devices to promote mobility and exploration of the environment. - Adaptations in the Classroom: • Implement an adapted physical environment with accessibility technologies, such as smart lights, adjustable desks, and interactive touch surfaces.

IDD	Possible Interventions
	• Use 3D printing to create custom adaptations, such as supports for communication devices and adapted writing utensils. - Collaboration and Communication with the Educational Team: • Establish constant and collaborative communication with health professionals, occupational therapists and other members of the educational team. • Use online platforms and educational management applications to share information and update student progress effectively.
X-Fragile	- Implement adaptive applications and software that focus on the specific needs of the student. For example, augmentative and alternative communication (AAC) apps, interactive educational games, and progress tracking tools. - Imitation and modeling with the help of an interactive robot. - Use touch devices and tablets with software designed for intuitive interaction and adapted to the student's motor skills. - Create an accessible virtual environment that incorporates visual, auditory and tactile elements to facilitate student understanding. - Use online learning platforms that allow customization of content according to individual needs.
Visual Disability	- Learning non-verbal social behaviors with the aim of preventing stereotypes. - Auditory stimulation. Essential to capture as much information as possible from outside; Some techniques could be: studying through recordings or learning to discriminate people's voices. - Visual stimulation as a specific training to optimize the rest of vision to the maximum. This visual rest can be decisive in promoting the independence and security of the student in their daily life. - Adaptation of learning rhythms. - Establishment of a literacy code, either in ink or braille. Thanks to this code, students will see their reading speed and comprehension increase, as well as their writing. - School support to delve into specific content that is required. - Define an appropriate timing following the curricular objectives according to the student's learning rhythms. - Adaptation of the environment based on the educational needs of the student. This includes the control of lighting in terms of quantity and quality; avoid glare; the location of the student in class (close to the teacher and the blackboard); optical and non-optical aids; photocopies with large print; etc - Teaching based on real-life objects and situations. - Verbalize all situations with concrete language. - Provide additional data in situations where the student cannot perceive meaningful information on his or her own. - Control noise in the classroom. - The figures must be presented without perspective. - Explore multiple objects at the same time.
Angelman Syndrome	- Very specific communicative intervention strategies are required - Work with different communication learning techniques, we can see in these children a certain communicative intention such as spontaneous gestures (pointing), certain vocalizations, and even the use of a limited repertoire of words - Explore what type of language therapy is the most appropriate and see what advantages each one offers us
Hearing Impairment	- Implement adaptive applications and software that focus on the specific needs of the student. For example, augmentative and alternative communication (AAC) apps, interactive educational games, and progress tracking tools. - Applications to develop fine motor skills through tactile and visual activities - Create an accessible virtual environment that incorporates visual, auditory and tactile elements to facilitate student understanding
Morse Syndrome	- Sensory Activities: Provide activities that engage the senses, such as exploring different textures, smells, and sounds - Sorting and Categorizing Games: Use games that involve sorting and categorizing objects - Fine Motor Activities: Implement activities that promote fine motor development, such as block manipulation, puzzles, or art activities with non-toxic materials - Use of Assistive Technology: Introduce assistive technologies, such as interactive educational apps or augmentative and alternative communication (AAC) devices, to facilitate learning and communication. - Interactive Storytelling: Use interactive stories that involve visual images, narration, and active student participation - Musical and Rhythmic Activities: Include musical and rhythmic activities that stimulate coordination and motor development - Imitation Games: Encourage imitation games that help the student develop social skills and improve understanding of everyday roles and situations

IDD	Possible Interventions
	- Tactile and Visual Exploration: Provide opportunities for tactile and visual exploration, such as manipulating objects with different textures or looking at visual images and materials - Language Development Activities: Integrate activities focused on language development, such as word games, picture association games, and communication skills practice - Creative Art Projects: Allow for creative expression through art projects that include different materials and techniques. This can be beneficial for cognitive development and emotional expression - Social Play Activities: Facilitate social play activities that promote interaction with peers, fostering social and emotional skills - Problem Solving Activities: Incorporate activities that require problem solving, either through puzzles, construction games, or math challenges tailored to their skill level
Down's Syndrome	- Adapt the curriculum and materials to your level and pace of learning - Encourage their participation and interaction with the rest of the class - Reinforce their achievements and motivate them with fun and varied activities - Establish fluid and coordinated communication with the family and other professionals
Severe developmental delay and cerebral motor disorder associated with hypotonia and ataxia pattern	- Visual-motor problems: avoid tasks that involve copying from the blackboard or from a book - Visual perception problems: reading materials should be clear, legible, and spaced; underline relevant items; use enlarged books and workbooks with the photocopier. - Attention problems: including several tasks on the same sheet of paper can be disruptive for the child: it is better to provide additional pages with one task on each. - Memory problems: frequent recall to check their work can be of great help to the child, as it allows them to evaluate their work and provides them with a model to work on executive functions. Oral recall is very useful for reading. - Executive processes: provide him with a structured environment with clear expectations; rehearse what is expected of him; establish priorities: what comes first, second, etc.; teach him procedures for identifying problems, obtaining information, making alternative solutions.
Cerebral Palsy, ADHD, Dyslexia Visual disorders, Mild to Moderate ASD, Epilepsy, Dysgraphia, Dyscalculia, Deafness, Williams syndrome, Down syndrome	The assembly of a small robot, based on a didactic kit. This assembly must be guided by a script, in which all the assembly and connections to be made are guided. After its assembly, simple programming challenges must be proposed, such as the realization of certain paths or movements, and you can even use music, so that these movements follow a certain choreography according to the music.
ADHD	- Integrate them in regular classes - Give constructive criticism on a regular basis - Provide immediate feedback - Give these students instant tokens or on-the-spot praise for work completion - Keep in touch with parents on a consistent basis is also a key to successfully integrate these students. - Keeping a routine and a schedule. Write changes on the schedule as far in advance as possible. - Giving special directions - Written Assignments - Deconstructing Tasks: Break tasks into smaller units - Better organization (Assignment Notebook, Color-Coded Folders, Work Partners) - Opportunities to Respond and to Move - Seating Arrangements (away from distractions) - Collaboration with parents
Dysgraphia	- Ask for an expert's help - Use technology and identify the most suitable activities for your pupil - Motivate the pupil and engage them in the activities (use their interests, hobbies) - Work with the pupil individually if necessary; involve the pupil's family - Help students take responsibility for their learning and demonstrate their understanding by creating exercises for their classmates - Always give positive feedback and encourage the pupil - Create safe and pleasant atmosphere in class, where pupils work together and help each other
Mild to Moderate ASD	- The autistic child will be able to interact with his peers during lessons, but needs to have a space that he is calm in and that he accepts - Visual aid by positioning geometric figures at the entrance to indicate the designated area for the children to stand when forming a queue. - Carpet squares, geometric shapes, or desk chairs as visual cues during meeting times to provide clear instructions to the child on their seating location.

IDD	Possible Interventions
	- Gave these students a clear plastic container (one for each subject) to store their work in instead of having them keep it in their desks. - Peer teaching, because this activity is highly beneficial for children with ASD as it helps them develop the skill of perspective taking
Speech Impairments	- Ask for an expert help (speech and language therapists) - Identify where the problems/causes lie - Interview parents to identify causes and the impact of the language problem on the child's participation in activities at home, school and other social environments. - Design an individualized therapy program & assist the process of recovery - Provide the child with advice and therapy to make the necessary changes to the child's speech - Help educators create a change in the child's communicative environment to make them feel more relaxed and comfortable in using their speech - Provide advice, training and strategies for parents, teachers, school staff to work with the child

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