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ENVIRONMENTAL EDUCATION AND STEAM APPROACH FOR VISUALLY IMPAIRED PUPILS IN KINDERGARTENS

GUIDELINES FOR PRESCHOOL TEACHERS

Various authors

Environmental education and STEAM approach
for Visually Impaired Pupils in kindergartens
(GREEN4VIP)-
Project N° 2022-1-IT-02-ka220-sch-000086906

ENVIRONMENTAL EDUCATION AND STEAM APPROACH FOR VISUALLY IMPAIRED PUPILS IN KINDERGARTENS (GREEN4VIP)
GUIDELINES FOR PRE-SCHOOL TEACHERS

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1. Introduction

Green4VIP is an international Erasmus+ project involving institutions from Italy, Greece, Poland, Spain, and Slovenia. The main aim of the Green4VIP project is to develop innovative and target group-oriented training materials for preschool teachers on how to plan, organise and implement environmental education workshops (based on STEAM approach) in class and online with kids aged 3–5, with a focus on the Visually Impaired Pupils (VIP).

The importance of early education provided by well-trained staff is crucial for visually impaired children who face difficulties in their inclusion inside mainstream classes, because kindergarten teachers do not know how to provide them with adequate content and tools, which they should use to convey such content appropriately.

<u>The project addresses its top priorities as follows:</u>

1. Provide support for initial and continuing professional development of staff involved in organising, leading, and providing early childhood education and care by supplying preschool teachers with competencies on suitable pedagogical strategies to address VIP;
2. Improve preschool teachers' awareness of environmental topics and contribute to enabling behavioural changes for individual preferences, consumption habits, and lifestyle;
3. Supply skills to preschool teachers to implement environmental workshops based on the STEAM approach and how to adapt it to the need of VIP;
4. Promoting all children, including VIP (and their families), awareness of environmental issues;
5. Update teachers' expertise in the use of digital tools, including accessible and assistive technologies;
6. Increase the quality of work in the Partner Organizations in the long term, as well as their capacity and professionalism to work at the EU level.

The results of the Green4VIP project are multidimensional and extend their impact at local, regional, and European levels. Specifically, the expected results will be the following:

→ **GREEN4VIP Guidelines for preschool teachers**, based on a research and online survey carried out in partner countries to investigate teachers' skill gaps in education for VIP, it will be a practical guide for teachers on how to implement learning and teaching processes with hints on how to deal with VIP;

→ **GREEN4VIP Teacher Training Curriculum**, aimed at supplying competencies to teachers on environmental issues, digital assistive technologies, and online learning, how to adapt the STEAM approach to VIP;

→ **GREEN4VIP Inclusive Toolbox for VIP**, a practical tool to implement inclusive environmental workshops based on STEAM in class and online, by describing step-by-step how to carry out the activities. Audio-described video tutorials will complement the Toolbox to provide an accessible and easy-transferable component.

2. Theoretical framework

2.1 Environmental Education and STEAM

In a rapidly evolving and changing society facing many environmental, health and economic challenges, the importance of science, technology and environmental literacy for the individual citizen is increasing. Effective education is important for developing environmental awareness, attitudes, values, knowledge and skills that prepare individuals for the challenges of modern society and responsible behaviour towards the environment (Aminrad et al., 2013; Ardoin et al., 2020). Early childhood is crucial for the development of the aforementioned literacies, as it represents a critical period for the holistic development of the child (Türkoğlu, 2019). Various studies (Cohen & Horm-Wingerd, 1993; Meier & Sisk-Hilton, 2017; Ardoin et al., 2020) investigating the effects of environmental education in the preschool period have found that children have better environmental awareness and knowledge and more positive attitudes towards the natural environment. Preschool teachers have an important influence on children's perceptions of science and technology and play an important role in identifying and transforming misconceptions (Yalcin & Yalcin, 2017; Lwo et al., 2017), but they have to take into account children's developmental needs, interests, and abilities (Boca & Saraçlı, 2019; Türkoğlu, 2019).

A STEAM approach can be used to improve science, technology and environmental literacy. The STEAM approach is an extension of STEM, which is an interdisciplinary approach to learning that integrates science (Science), technology (Technology), engineering (Engineering) and mathematics (Math), whereby learning about concepts in each area is derived from real-life situations (Tsupros, Kohler & Hallinen, 2009). The STEAM approach also includes the arts as an opportunity to develop creativity and innovation, as art is subjective and thus a counterbalance to objective science. This approach encourages children to explore, debate, solve problems, develop practical skills and critical thinking, and to work collaboratively with peers. In addition, it stimulates imagination and develops creative thinking and skills (Keane and Keane, 2016; Herro and Quigley, 2016; Bequette and Bequette, 2012; Glass and Wilson, 2016; Syahmani et al., 2021). Children are more actively involved in the learning process, are more motivated and show more interest in these areas (Henriksen, 2014).

2.2 Inclusive Education

The inclusive paradigm can be understood as a response to ableism, which is based on beliefs, and social and institutional practices that pursue the assumption of a healthy and capable individual and consequently perceive special needs as a state of permanent disadvantage (Campbell, 2019). This contributes to the marginalisation of people with disabilities and their exclusion from the education system and society in general.

Special needs can be understood in two ways: as disabilities resulting from sensory, physical, cognitive, and mental limitations in an individual's functioning, or as disabilities resulting from limitations in society and in an individual's social environment, which significantly restrict their inclusion (Gershel, 2002). Inclusion thus addresses all those at risk of exclusion for different reasons. Since it is already well known that both kindergarten and school can reproduce social inequalities, inclusion must necessarily be understood as a pedagogical-social paradigm, a principle that guides our actions throughout life. Its fundamental purpose is thus: (1) to ensure wider access to quality educational programmes (UNESCO, 1994), (2) to respond to children's different needs in an individualised way (Peček and Lesar, 2006), and (3) to increase opportunities for children to

participate actively and to achieve success in different (developmental) areas (Unesco, 2009). Regardless of a child's specific needs, every child has the right to active participation in the educational process and the right to learn and build knowledge. In this sense, quality STEAM content should also be accessible to VIP.

Children with visual impairment need planned additional professional support in inclusive schooling, especially in overcoming their own deficits and in the areas identified as weaknesses and developed in the extended curriculum for children with visual impairment: assistive technology, sensory efficiency, compensatory access, orientation and mobility, social interaction, leisure and recreation activities, independent living, self-determination, and career orientation.

3. Research methodology

In line with our objectives, we planned a qualitative survey through desk research and a quantitative survey conducted through a questionnaire

3.1 Desk research

Desk research was carried out in each partner country in spring 2023. It included the following tasks and open-ended questions:

- Describe the way of inclusion in the educational system of your country.
- Describe the education of VIP in your country.
- *Whether and how digital pedagogy is included in the kindergarten curriculum in your country? Whether educators use online learning?*

3.2 Quantitative survey

3.2.1 Instruments and procedures

The questionnaire was accessible online (Google Forms) and completed by preschool teachers from the participating countries in March 2023. The questionnaire was anonymous and took 10–15 minutes to complete.

The questionnaire used was a survey questionnaire designed for the purpose of the study. The questionnaire was based on Ravenscroft, Davisbo, Bilginc and Wazni's (2019) questionnaire of factors influencing teachers' views on inclusion of children with visual impairment and a questionnaire relating to preschool teachers' views on the STEAM approach (K4K, 2020). The questionnaire consisted of three parts: the first part consisted of 5 demographic questions (gender, work experience, work experience with children with visual impairment, education and kindergarten status); the second part related to inclusion and included items on understanding visual impairment; the third part consisted of items on the STEAM approach in relation to children with visual impairment. In the final section, questions on the use of digital technology in kindergarten were added. The questions were closed and open-ended, the closed questions were written according to the Likert scale of attitudes.

3.2.2 Sample

The sample was purposively selected. The research included 189 preschool teachers from five European countries - 34 from Greece, 60 from Italy, 33 from Poland, 32 from Slovenia and 30 from Spain. In all countries, the sample was made up of female preschool teachers, only in Italy, there were 26.6 % male preschool teachers.

The majority of the participating preschool teachers have a bachelor's degree, except for Poland, where most preschool teachers have completed a master's degree (94.3 %). Most of the participants

are employed in kindergartens with public kindergarten status: Greece 97.1 %; Italy 63.3%; Poland 80.0 %; Slovenia 100%; Spain 64.5 %.

There are differences between countries in terms of work experience in educational institutions. In Greece and Spain, preschool teachers with 16–25 years of experience were predominant, while in Italy and Slovenia, preschool teachers with 6–15 years of experience were the most numerous. In the Polish sample, preschool teachers were evenly distributed in terms of experience (Figure 1).

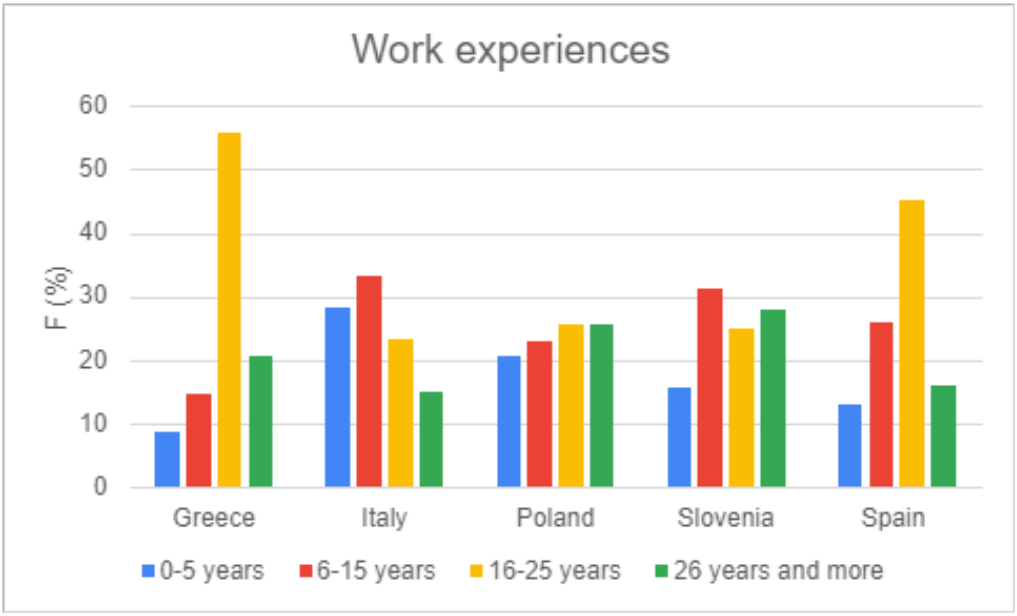

Figure 1 - Preschool teachers' work experience in educational establishments by country

In all countries, most preschool teachers appeared to have no experience of teaching children with visual impairments, except for Spain, where the sample consisted mainly of preschool teachers (58.1 %) who had previous experience of teaching children with visual impairments.

The majority of the preschool teachers included in the study were favourable towards inclusion, with the Italian (M=4.9) and Spanish (M=4.43) preschool teachers standing out in terms of their favourability, while the Greek (M=2.42) preschool teachers expressed a lower favourability towards inclusion (M=2.42). Preschool teachers from Poland (M=3.6) and Slovenia (M=3.6) also favoured inclusion.

4. Results and Discussion

4.1 Results from the Desk Research

We present the international results that led to the Green4VIP guidelines.

4.1.1 Inclusive Education in Partners Country

Inclusive Education in Italy

In Italy, the laws 517/1977 and 270/1982 state the right to inclusive education in compulsory schooling for students with disabilities. Article 12 of law 104/1992, then, establishes the Right to education and training to all forms of disability, ensuring inclusion in the common classes of nursery school, kindergarten and establishing the objective of school integration for all disabled pupils.

In 2009, to improve the process of integrating students with disabilities into mainstream education, the MIUR (Ministry of Education, University and Research) has drawn up the Guidelines on the school integration of pupils with disabilities which provide practical indications to teachers and preschool teachers.

Children with disabilities can be, at the request of the family, certified as “disabled” in accordance with law 104/1992. This certification is the document which, starting from the diagnosis and pathology, indicates the type of disability and its severity, as well as the possible need for personal assistants, rehabilitation treatments and the right to a support teacher.

This certification is accompanied by the drafting of the Functional Diagnosis. The Functional Diagnosis is the analytical description of the functional impairment of the pupil's physical state. This document is drawn up by a special commission and is aimed at the psycho-social recovery of the child.

Once the certification of the disability and the functional diagnosis have been obtained, they must be delivered to the school. This way, the process that leads to the allocation of the necessary resources such as support teachers, can start.

Afterwards, the teachers together with the specialists of the local health authority prepare the Functional Dynamic Profile, a document which identifies the possible level of development of the pupil in various areas, to finally arrive at the preparation of the Individualised Educational Plan which indicates the school path to be activated.

To conclude, it is possible to request special teaching aids for disabled pupils. Children and young people attending any school are entitled to get them. These tools are provided free of charge. The request must be forwarded by the competent local health service (Informafamiglie, 2023).

According to the data held by Italian Union of the Blind and Partially Sighted (UICI), there are approximately 4000 visually impaired students followed by the Tyflo-educational Counselling Centres of the Federation for the Blind and the Library for the Blind. The data provided by MIUR confirm the number of visually impaired students enrolled in Italian schools is around just over 4000 units (1.6% of the approximately 235000 students with disabilities).

Regarding the process of diagnosis and the allocation of resources needed for VIP educational support at school, please read the previous paragraph. Visually impaired pupils enrolled in all Italian schools and usually follow the same teaching programmes as the other pupils, but with some adaptations in particular in relation to the materials used. They are also assigned a support teacher and sometimes an "assistant/facilitator" of the communication, a professional envisaged by Art. 13 of Law 104/1992. These professionals take care of the adaptation of the material e.g., making it accessible to screen-reader, translating it into Braille code or creating tactile drawings.

Unfortunately, the presence of a support teacher, almost always with little (or any) skills in Tyflo-pedagogy and with a vague knowledge of Tyflo-technical tools, often hinders the children's integration process.

Today, in fact, we are witnessing a lack of specific preparation provided to specialised teachers by the institutes of psychology and educational sciences of Italian Universities and, due to the already mentioned small number of visually impaired students (less than 2 % of all disabled Italian students), teachers' preparation is increasingly "undifferentiated" and "generalist", reducing the teachings reserved for blindness and low vision to just a few hours or even units (Braille method, Tyflo informatics , use of assistive technologies, etc …).

To conclude, children have much more complex rehabilitation needs than adults because the visual impairment affects numerous areas of development and learning. Congenital or early visual impairment determines, for example, a risk situation for the development of the following skills:

- Oculomotor, motor and psychomotor skills
- Cognitive skills (categorization, analytical/synthetic processes, mental representation)
- Neuropsychological functions (attention and memory)
- Relational, communicative and linguistic skills

- Formal learning.

A child with visual impairment often shows a global delay in psychomotor development: this is only partially attributable to the specificity of the visual impairment, given that the biggest problems often arise from the lack of early and targeted educational and rehabilitative interventions and adequate family support. Early rehabilitation intervention services fill this gap, placing themselves as a specific intervention for pre-school children. Through individual rehabilitation interventions that take into account the degree of development, the personal characteristics and the environmental peculiarities in which the child lives, the service aims to monitor the relational, cognitive, motor and possibly visual development of the little ones, supporting families in this delicate phase of growth. Some early intervention rehabilitation activities may concern:

- Visual stimulations
- Psychomotricity
- Neuro-psychomotor skills
- Daily living skills
- Pre - orientation & mobility
- Speech therapy for dysphagia problems or speech problems
- Music therapy.

Unfortunately, however, these early intervention services for kids are available on the Italian territory in an uneven way and are provided by different private and public institutions.

Inclusive Education in Greece

In Greece, the educational system for Visually Impaired Pupils (VIP) is inclusive and comprehensive, starting from the preschool level (Ministry of National Education and Religious Affairs, Pedagogical Institute, 2004). Special kindergartens and inclusion sections within mainstream kindergartens are integral parts of this system.

Special kindergartens are dedicated to children with special educational needs (SEN), including VIP. They offer a tailored curriculum, a smaller student-to-teacher ratio, and specialised support staff trained to work with VIP. These kindergartens, found in major cities like Athens, Thessaloniki, and Patras, have environments and resources designed to accommodate the unique needs of VIP.

In mainstream kindergartens, inclusion sections are set up to integrate VIP with their peers. These sections are supported by special auxiliary staff, professionals trained to assist VIP and facilitate their inclusion. They may include special education teachers, mobility instructors, and therapists.

A noteworthy example of specialised education for VIP is the Preschool Department at the Centre for Education and Rehabilitation of the Blind (KEA) in Kallithea. This public institution caters to the needs of VIP, aged 3 to 5 years old. The department offers a specialised care program that starts from birth and extends up to the age of five, helping these children gain essential skills and become ready for their future educational journey.

Thus, Greece offers a comprehensive, inclusive system for the education of VIP, beginning from the earliest stages of childhood.

In Greece, the education of Visually Impaired Pupils (VIP) starts from early childhood, with institutions like the Centre for Education and Rehabilitation of the Blind (KEAT) playing a crucial role. The pre-nursery department of the KEAT is dedicated to children aged 0-3 years and offers a comprehensive program tailored to each child and their family. This program includes family support and advice, assessment of the child's abilities, identification of difficulties, pedagogical guidance, and efforts to integrate them into society.

For children aged 3-5 years, the KEAT implements a daily educational program on its premises, complemented by a follow-up program for the family and the child at home. This holistic approach ensures a continuum of support and learning both at school and in the home environment.

The department is staffed by qualified personnel, including preschool teachers specialising in blindness, music preschool teachers, and curators. Their expertise contributes to a diverse and enriching learning experience for the children.

In addition to the educational programs, the KEAT provides additional assistance like physical education for children, a library, and a printing house to create Braille books and talking books. Their laboratory also creates specialised materials like embossed pictures, maps, and models to facilitate learning for VIP. Moreover, a psychological service is available to provide mental health support to the children and their families, highlighting the holistic approach that the KEAT takes in educating and supporting VIP.

Inclusive Education in Poland

According to the Constitution of the Republic of Poland (Article 70), every child has the right to education. Children with disabilities can exercise this right in the school closest to their place of residence. For this reason, children with various disabilities also study in mainstream schools.

It is estimated that in Poland about 4-5% of children have a certificate of the need for special education - due to disability. In the example of the city of Krakow, it is 4 percent of children, of which 2.5 percent attend kindergartens and mainstream schools, and 1.5 percent attend kindergartens and special schools (A Child Is a Child, 2023).

In Poland, there are various forms of special education, which are organised for pupils with special educational needs, having a certificate of the need for special education. Such decisions are issued exclusively by public counselling and guidance centres at the request of a parent (legal guardian). Pupils in special education require the special organisation of learning and working methods and specialist support due to disability, risk of social maladjustment or social maladjustment.

In general, in Poland special education is organised in nursery schools (mainstream, mainstream with integration classes, integration classes, special schools), schools (mainstream schools, mainstream schools with integration classes, integration classes, special schools, special schools preparing for work), and special education centres.

Parents (legal guardians) play a key role in choosing a school for their child, even though it is the role of counselling and guidance centres or other counselling centres with the power to adjudicate on the most appropriate school.

Therefore, the model in Poland is the possibility of choosing between a kindergarten or a mainstream school, integration (where there are children with different disabilities) and a special education kindergarten or school.

In Poland, inclusive education is not the purpose for which special schools are to be abolished. In recent years, the number of students in special schools has increased by 9,000. The number of special schools is increasing. But the number of children with special needs in mainstream schools is also increasing. Over the last 11 years, the number of children with a broad autism spectrum has increased 10 times in Poland. This may indicate better diagnostics, it may indicate civilization problems, but also that parents are aware that if their children do not obtain a certificate of disability, they will not receive adequate support at school (A Child is a Child, 2023).

Children may experience difficulties temporarily, so it is important to provide specialist support quickly even if the child does not have a disability certificate. It is important to support your baby in the first months of life, early support is important. “If we change the beginning of a child's story, we can change their entire story.” (A Child is a Child, 2023).

The aim of the actions currently taken in Poland is to support children as much as possible, as far as possible, as various pedagogical thoughts and experiences develop, without thinking in terms

that it is only easier and simpler here and now, but to have the perspective of their adult life and prepare them to live their adult lives with dignity and in the most active way possible.

As part of the public debate, there are the voices that the actions taken towards the inclusion are aimed at closing special education schools or limiting it. In reality, the current policy is not intended to extend or limit special education, but to ensure that education, whether in mainstream or special schools, is as adequate as possible for every child and gives them a chance to live a good life in the future.

In Poland, there are about 277,000 children with special educational needs. About 18 billion PLN per year is transferred to their specialist support (A Child is a Child, 2023).

The goal is to create an education system that will support every child with special educational needs, including those children who do not have this type of certificates or opinions, because education is supposed to support the development of every child, give every child a chance.

The intention is to implement education wisely, bearing in mind the education of a human being who has competences, but at the same time is to be a sensitive man, open to the other, a human being who can sometimes limit himself and work for the benefit of others.

Inclusive education has been present in Polish schools since the 90s, but currently actions are being taken to make it effective, to give every child a chance to develop.

There is no chance that inclusive education will be effective, especially in the case of children with severe disabilities, without providing support at the highest level: substantive, psychological and technological. In every respect, the support system for schools, for teachers, is crucial. Detailed solutions are needed to help teachers work in the belief that the interests of all children are properly safeguarded.

Professional development of teachers is very important. The professionalism of teachers is the well-being of children and finding a happy and proper place in life.

Currently, there are 23 Specialist Centres Supporting Inclusive Education in Poland (as per end of May 2023). They are funded under the EU programme. It is planned to finance in the near future as part of another project 285 such centres. It is planned that ultimately at least one such centre will be located in every county (there are 314 counties in Poland).

The role of these centres (SCWEWs) is to work for the inclusion of all children with special educational needs, including children with visual impairment. They provide specialist assistance to

teachers working with children in mainstream schools who need periodic or permanent various support.

SCWEWs have their roots in special education. This is a pillar of knowledge and experience (A Child is A Child, 2023).

As far as visual disabilities are concerned, mainstream schools are most often attended by partially sighted pupils, but blind people also use this possibility.

Special schools for visually impaired children have the same education curriculum as mainstream schools.

When choosing a school, various factors are taken into account: the child's abilities, the type and degree of disability, the resulting needs, family situation, including the willingness of parents to engage in cooperation with the school and participation in the didactic process, place of residence, preferences, interests, plans and life prospects of the young disabled person, school possibilities, access to support from specialists.

Visually impaired pupils are people experiencing the consequences of ophthalmic diseases, but also, increasingly, the consequences of neurological diseases. They differ in the degree of damage of central vision and peripheral vision, i.e., the possibility of using such visual functions as:

- visual acuity,
- field of vision,
- sensitivity to light and contrast,
- colour vision,
- perception of movement and shape.

A student can function quite well visually, and a moment later like a blind person – this applies to some visually impaired children.

In general, there is no equality between one visually impaired pupil and another. Students with the same eye diseases may have different visual abilities. The basis for the knowledge of what visual capabilities a given child has been the results of a functional assessment of vision, which is carried out, for example, in SCWEW – typhlo pedagogists with competences in the field of vision rehabilitation deal with this (A Child is a Child, 2023).

Inclusive Education in Slovenia

Targeted work with people with special needs in Slovenia dates back to the beginning of the 20. century, when the first special schools were established. However, special education was developed after the Second World War (Opara, 2009). In 1995, the White Paper on Education (Bela knjiga o vzgoji in izobraževanju v Republiki Sloveniji, 2011) laid the foundations for inclusive education for people with special needs in Slovenia, followed by a change in legislation. Five years later, the Act on Guidance of Children with Special Needs was adopted, which regulated all specific issues related to the education of children with special needs. As the legislation thus regulated did not fully cover the challenges of early treatment of preschool children with special needs, the Act on Integrated Early Treatment of Children with Special Needs was adopted in 2019. The latter is based on (1) understanding of child development, as it takes into account the importance of as early, continuous and intensive treatment as possible and (2) the eco-systems theory (Bronfenbrenner, 1995), which foresees the integration of the educational, social and health aspects of the treatment and inclusion of children with special needs. The importance of family support has also been recognised in order to ensure and promote the holistic development of the child, to strengthen the capacity of the family and the social inclusion of both the child and the family. In the pre-school period, a child with special needs can be placed, depending on the severity of his/her special needs, to two different educational programmes; a programme for pre-school children with adapted delivery and additional professional support and an adapted programme for pre-school children. While in the first case the organisation and delivery of the programme is adapted and additional professional support is provided, in the second case the content is adapted, but no hours of additional professional support are provided, as the special educational assistance and support for the child with special needs is continuously provided within the programme. Children with special needs are also provided with special aids and physical assistance if the need arises.

Organised education for people with blindness and visual impairment began in Slovenia after the end of the First World War, more specifically in 1919, when the need for such education arose due to the increased number of blinded soldiers. For most of its historical development, children with visual impairments were enrolled in specialised institutions operating under different names in different locations. Currently, there is only one educational institution in the Republic of Slovenia, the IRIS Centre for Education, Rehabilitation, Inclusion and Counselling for the Blind and Visually Impaired in Ljubljana, which caters to the entire population of preschool children, pupils, and students.

The first contact of children and parents with the IRIS Centre is usually through an early intervention programme, which is carried out on an outpatient basis at the centre's headquarters, or, in

exceptional cases, in the home environment. Early typhlo-pedagogical intervention of children with a visual impairment covers the time from the time of diagnosis or suspicion until the child is referred to the appropriate primary school programme. The aim of early intervention is to ensure the smooth psychosocial and physical development of children, to empower families and to socially integrate children and their families into the wider social context. When a child is enrolled in an early intervention programme, a comprehensive assessment of the child is carried out, with particular emphasis on the assessment of visual functioning. This is a follow-up to the clinical diagnosis and tells us how effectively the child is using his/her vision.

To the extent that the professional team judges that the child will need help and support from professionals during his/her schooling, the child can be included in various programmes for people with special needs:

- a programme for preschool children with adapted provision and additional specialist support,
- adapted programme for pre-school children,
- educational programmes with adapted delivery and additional professional support,
- adapted education programmes with an equivalent educational standard,
- adapted education programmes with a lower educational standard,
- special education programmes for children with moderate, severe and profound intellectual disabilities and other special programmes (hereinafter referred to as special education programmes),
- educational programmes.

Roughly speaking, children with visual impairment have a choice between being included into specialised institutions or mainstream educational programmes. The vast majority of children with visual impairment are currently enrolled in a primary school programme with adapted provision and additional professional support. Under the new legislation, all pupils, regardless of the type and duration of the programme, should be entitled to additional professional assistance, which is provided by a qualified professional to overcome deficits, barriers or disabilities. At present, a major challenge in Slovenia is the provision of professionally qualified staff, as the programmes of typhlo-pedagogics and special-pedagogical advanced training of teachers to work with people with visual impairment have not been implemented for several years.

Inclusive Education in Spain

Currently, more than 99% of visually impaired students attend regular schools in their town, neighbourhood or city of residence, following the official school curriculum. These students receive complementary attention according to their specific needs related to visual impairment (Braille teaching, new technologies, personal autonomy, orientation and mobility or social competence, among others), which is provided by the specialised professionals of the Specific Teams for educational attention to visual impairment.

As for the legal framework, education is governed at the state level by the Organic Law 3/2020, of December 29, known as LOMLOE, which has inclusion as one of the fundamental pillars. The Convention on the Rights of Persons with Disabilities appears as a key principle of the Education Law (Art 1.B) and specifies that there can be no discrimination on the grounds of disability, based on the Convention on the Rights of the Child and Quality Education (Art 1.a and 1.a.bis). That is to say, the disability of the students cannot be an excuse to offer them an education of lesser quality.

It maintains as a principle the "freedom of education", which recognizes the right of parents and legal guardians to choose the type of education and the school (Art. 1.Q.), which obliges the educational community to respond to the needs of VIP children not only in the centres previously known as "special education".

Finally, the curriculum cannot be a barrier that generates school dropout or prevents access to the enjoyment of the right to education". (Art 6.2). This means that it cannot be alleged that a student cannot access the curriculum in order to refer him/her to special education. Each student will be evaluated according to what is included in his/her Individual Curricular Adaptation (ICA); which increases the inclusivity of VIP children but generates new demands for training and resources for teachers so that they can carry out these adaptations.

In Spain, different professionals participate in the diagnosis: the Ophthalmologist, the Specialist in Education of the Blind, the psychologist, the Kinesiologist, the Occupational Therapist, the Speech Therapist and the Social Worker. At the end of this process, gathered in a team, the professionals deliver their diagnoses and, together, elaborate the differential diagnosis, proposing lines, both for treatment and action, to achieve successful learning in the school environment and, for this, the elaboration of curricular adaptations plays an essential role.

In the presence of a student with low vision or blind in the classroom, the most common organisational-didactic adaptations are usually: use of alternative means to the usual ones for the

fulfilment of the different curricular objectives, attending, at each moment, to the pace at which the student performs the different school tasks, installation in the classroom of specific instruments and didactic material, verbalising what is written on the blackboard, reiterating the presentation of information or flexibility in the choice of evaluation systems.

Modifications are also made to the physical space and the provision of technical resources aimed at guaranteeing adequate access and reproduction of information: books, embossed materials, Braille typewriters, etc. Adaptations to access the curriculum must be accompanied and reinforced by the application of certain specific programs of extraordinary importance: Braille reading and writing, visual stimulation, comprehensive rehabilitation (orientation and mobility and daily living skills), etc. All of this is supported by the Special Attention Teams (itinerant teacher) that guide the teacher throughout the process.

4.1.2 Digital pedagogy for online learning and use of digital tools including assistive technologies for VIP in Partners Country

Assistive technology for children with visual impairment in Italian kindergartens

In Italy, digital pedagogy is included in the preschool curriculum only in the form of games or supplementary support to test the notions already learned by pupils. It is not used as a form of learning because it has been noted that pupils tend to be easily distracted and learn less information and in a more meagre way.

The same justifications are applied to the use of online learning, as it has been ascertained - especially during the pandemic - those pupils in particular in the range under consideration, do not follow the teacher carefully and do not hang what is necessary. In addition, a number of researches aimed at evaluating online learning have been developed in Italy, but few of them refer to the 0-10 age group.

Before we begin to discuss the digital technologies mainly used to integrate the learning of children with visual impairments, it is necessary to specify that the techniques listed below are mainly used from age 6 onward. In that for children in the 0-6 range, the use of integrative learning techniques using manual, embossed and audio supports such as Thermoform prints, multisensory and experiential tools and aids is preferred. However, the tools listed here above provide support related mainly to learning through play.

Moving instead to the 7-18 range (or at least to the end of schooling), the digital technologies used to supplement the learning of pupils with visual impairments are varied and apply to different areas of teaching.

The main hardware tools are scanners, video magnifiers, braille displays, and braille printers. As for software, the main ones are speech synthesis and screen reader, OCR, enlargers, and book reader. There are also other programs created specifically to enable specific learning of certain techniques.

The following is a brief description of some of the items just listed.

Screen reader and speech synthesis: the two systems go hand in hand; the screen reader is software that describes to the blind, or visually impaired, the content shown on the computer screen. Speech synthesis, on the other hand, allows any electronic text stored in the computer to be transformed autonomously into speech. The two software programs can be started in sync, translating into faster handling for more experienced users.

Scanners and OCR: the scanner allows an image to be captured and transformed into a digital format, while OCR (Optical Character Recognition) recognizes the characters in an image and handles their transformation into a digital format.

Magnifiers: allow the device's video to be enlarged without altering its characteristics and is mainly used by the low vision.

Video magnifiers: electronic devices that allow, by means of a camera and a monitor, the reproduction and enlargement of a text or object of reduced size.

Braille display: a device that, when connected to a computer, allows people to read by touch by sliding their fingertips over the bar; the text that appears on the screen is automatically converted to braille. Braille displays use computer braille, which allows more characters (256), and is driven by the screen reader.

There are various programs developed to train people with visual impairments to use the keyboard and computer, but those in Italian and suitable for children are not many. These include Erica, Omnibook, and 10dita. The latter is the one most widely used in our country, as it provides 61 progressive lessons with exercises specific to the topic covered but also general on the whole.

As for learning assistance in science subjects, the programs mainly used in Italy are LAMBDA and BrailleMath. The latter are mainly used by blind students, since the visually impaired can appropriately enlarge the characters; but the general exploration of formulas and their analysis still remains a major problem (Pieri, 2011/2012).

Assistive technology for children with visual impairment in Greek kindergartens

Digital pedagogy is increasingly emphasised in the kindergarten curriculum in Greece, underpinned by the 2003 Integrated Thematic National Curriculum (Ministry of National Education and Religious Affairs, Pedagogical Institute, 2003). The curriculum prescribes the use of Information and Communication Technology (ICT) and IT in early years education, offering clear instructions for teaching children the basic functions of the computer and its application in everyday activities. This provision for the use of ICT is cross-curricular, linked to all subjects to create a comprehensive digital learning experience.

The use of technology in early years' education is perceived as beneficial for fostering digital literacy skills from a young age. Interactive whiteboards, educational apps, digital storytelling tools, and tablets are commonly used, enhancing learning and making it more engaging. Teachers are trained to use these technologies, including educational software and digital games, ensuring effective integration of technology into teaching methods.

In recent years, the evolution of digital education in Greece has been significant. More kindergartens have been equipped with interactive whiteboards, tablets, and digital machines. The period of tele-education further improved teachers' familiarity with these tools. In 2021, the "Digital Kindergarten" initiative was launched as a pilot implementation of ICTs in 200 kindergartens.

However, the use of online learning in kindergarten is typically limited, considering the young age of children and the pedagogical emphasis on play and social interaction. While some level of digital engagement is encouraged, any digital activities are closely supervised by preschool teachers and are designed to complement, not replace, traditional teaching methods. This balanced approach underscores Greece's commitment to fostering digital literacy while preserving the core values of early childhood education.

In Greece, digital technology plays a pivotal role in the education of Visually Impaired Pupils (VIP), despite some limitations in equipment availability. Currently, equipment typically includes a projector and a touchscreen, which are used to present visual information in an enlarged or tactile format that can be more accessible to VIP.

However, the potential of technology in VIP education extends far beyond these tools. For instance, a Greek language speaking pocket computer could be employed to assist with reading and writing tasks, providing auditory output for VIP. This tool can help VIP access educational content and communicate more effectively.

A particularly transformative tool would be the provision of personal computers for each blind pupil, equipped with modern assistive technology. These computers could have screen-reading software, which can read out text displayed on the screen, and Braille display devices, which convert text into Braille. Additionally, they could be equipped with Braille translation programs and tactile graphics software, which can be used to create raised-line drawings that VIP can feel.

Despite current limitations, such technological enhancements could significantly improve the integration of VIP into the learning process, making education more accessible and effective for them in Greece. The adoption of such technology, alongside proper training for preschool teachers and students, is crucial for advancing inclusive education in the country.

Assistive technology for children with visual impairment in Polish kindergartens

It seems that in Poland digital devices are not used very much in the kindergartens. The only electronic devices used are electronic magnifier and interactive whiteboard.

Assistive technology for children with visual impairment in Slovenian kindergartens

Slovenia has a 1999 Kindergarten Curriculum, so it is not surprising that it does not include digital content. As digitalisation of education is one of the objectives of the European Recovery and Resilience Plan, it is to be expected that digital technologies will be somehow included in the curriculum renewal. In this context, it is important to stress that the digitisation of early childhood education must be geared towards empowering children to use digital technology in a safe and meaningful way. With this in mind, some kindergartens are choosing to use educational robots (e.g., BlueBoot) for the purpose of developing computational thinking, but creative practices are isolated and still at an early stage.

In the context of an extended curriculum for people with visual impairments, special attention is also being paid to the introduction of assistive and augmentative technology. Children are eligible for assistive devices through a referral or order for medical or technical aids. Unfortunately, the referral or order form covers the value of the device up to a certain value, for the rest there is an individual surcharge.

In the pre-school period, the need for specialised equipment and assistive technology is relatively small and usually remains limited to the use of a Braille machine for children with blindness or the testing of electronic magnifiers for children with visual impairment, which they will need later in their schooling.

However, the need for specialised equipment increases exponentially during the course of schooling. The most frequently used devices include a laptop with specialised software, a smartphone, a braille reader, audiobook players....

Assistive technology for children with visual impairment in Spanish kindergartens

With the current Education Law, known as the LOMLOE, the Early Childhood Education stage (3-5 years) is the beginning of the process of acquiring the key competencies for lifelong learning that appear in the Recommendation of the Council of the European Union of May 22, 2018. One of them is the *Digital Competence* that initiates, at this stage, the process of digital literacy that entails, among others, access to information, communication and content creation through digital media, as well as the healthy and responsible use of digital tools. In addition, the use and integration of these tools in classroom activities, experiences and materials can contribute to increase motivation, understanding and progress in the acquisition of learning of boys and girls.

In order to favour the inclusion of all students, special attention will be paid to the accessibility of manipulative materials in the classroom. Likewise, the design of daily activities must be approached from an approach that prevents discrimination; to ensure the emotional well-being and promote the social inclusion of students with disabilities, interaction with peers in the development of such activities will be guaranteed. Likewise, the possible specific communication and language needs of students with disabilities shall be taken into account.

As an early childhood educator, that is, as a guide person for the child, propose pre-arranged breaks and allow the student to be visually focused for shorter periods of time.

Before answering the questions, it is important to analyse what educational objectives are set for early childhood education in Spain. Knowing what knowledge, skills, attitudes, aptitudes, abilities and/or basic competencies - in this case related to STEAM competence - a child of 3, 4, 5 and 6 years of age has to achieve (GREEN4VIP target group) will help us to understand the situation of VIP, their needs and the needs of their teachers too.

According to the legal framework, during childhood (from 3 to 6 years of age), the STEAM competences at this age are aim to:

a) Mathematical competence and competence in science and technology.

   Once the evolutionary achievement of the "permanence of the object" is reached, the child initiates goal-directed behaviour, invents new solutions and arrives at the logic of actions. These advances open the door to the possibility of proposing in Early Childhood Education activities and learning situations related to processes of observation, manipulation,

classification, seriation, counting, the approach of ideas, the beginning of reasoning or explanation of some phenomena of the closest natural environment, tasks that favour the beginnings of logical reasoning before the age of 6 and that contribute to the development of skills related to mathematics, science and technology.

b) Digital competence.

The process of digital literacy begins in Early Childhood Education, and knowledge and skills related to information, communication and technology are introduced, accompanied by the responsible use of digital tools.

The most common technological resources depending on age are:

Dancing or stimulation mat (from 6 months to 6 years), RFID (from 12 months to 6 years), Digitizer tablet (from 18 months to 6 years), Optical reader leo (from 18 months to 6 years), Recording panel (from 12 months to 6 years), qwerty keyboard (from 3 to 6 years), Braille line and keyboard (e 3 to 6 years), computers, interactive whiteboards, Google Home, Alexa or Siri devices.

Sensory stimulation corners (with various materials such as models, different textures, ect) are just as important as oral description of visual physical realities that are difficult to access to their kind. Finally, perhaps due to the fact that Spanish educational centres are not as well equipped as teachers would like from a technology point of view, it should be noted that the eyes of the blind child are often the perceptions and descriptions of their peers and teachers.

4.2 Results from the Questionnaire

Preschool teachers' views on inclusion

First, we were interested in preschool teachers' views on inclusion and related topics (e.g., reflection on their own inclusive practice, professional development, experiences with inclusion). The results are presented in Table 1.

Table 1: Preschool teachers' views on inclusion (mean value for each country).

	Greece	Italy	Poland	Slovenia	Spain
How much experience do you have in developing inclusive practice or promoting it?	2.68	2.67	2.06	3.66	3.52
How much knowledge about inclusion did you acquire during your education?	2.24	3.47	2.15	2.63	2.00

How much did you acquire about inclusion during your further education and training?	3.15	3.65	2.77	3.56	2.26
How often do you incorporate the insights you have gained through research into your teaching practice?	3.21	4.33	3.06	3.50	3.13
How do you self-reflect on pedagogical practice (e.g., how open are you to change)?	4.26	1.92	4.06	4.19	4.52

Preschool teachers from Slovenia consider themselves to have quite a lot of experience in developing and promoting inclusive practice (M=3.66), followed by preschool teachers from Spain in terms of self-assessment (M=3.52). Preschool teachers from Greece (M=2.68) and Italy (M=2.67) are undecided about their experience. Preschool teachers from Poland, on the other hand, rate themselves as having little experience in this field (M=2.06) (Table 1).

The majority of preschool teachers from Greece (M=2.24), Poland (M=2.15) and Spain (M=2.00) report having gained very little experience/knowledge in inclusive education during their initial training. Preschool teachers from Italy (M=3.47) and Slovenia (M=2.63) were neutral about the experience/knowledge they had gained (Table 1).

In the context of further education and training, preschool teachers from Slovenia (M=3.56) and Italy (M=3.65) rated that they had gained knowledge about inclusive education, while preschool teachers from Greece (M=3.15) and Poland (M=2.77) were undecided on this question. However, preschool teachers from Spain (M=2.26) felt that they had gained very little knowledge about inclusive education through further education and training (Table 1).

Preschool teachers from Italy (M=4.33) often integrate scientifically based findings into their pedagogical work, while preschool teachers from the other countries were undecided on this issue (3.06≤M≤3.21) (Table 1).

For their part, preschool teachers from most countries consider themselves reflective about their teaching practice and thus in favour of change (4.06≤M≤4.52), whereas the opposite view is held by preschool teachers from Italy (M=1.92) (Table 1).

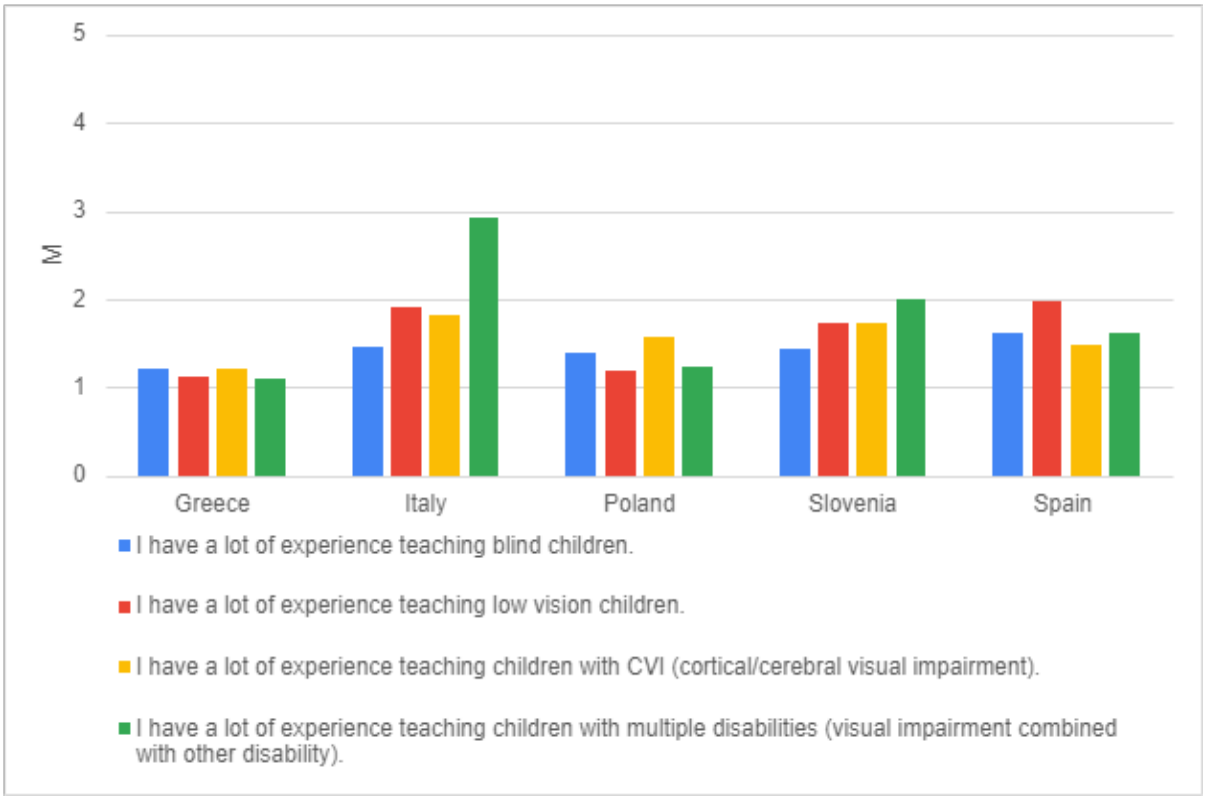

Figure 2 - Preschool teachers' experience of working with children with different visual impairments (1- no experience; 5- a lot of experience) (mean value for each country).

Further, we wanted to know how much experience preschool teachers have of working with children with different types of visual impairment (Figure 2).

Preschool teachers in most countries did not agree or strongly disagreed that they had much experience teaching children with blindness (1.21≤M≤1.61), children with visual impairment (1.12≤M≤1.79), children with visual impairment with CVI (1.12≤M≤1.38). Preschool teachers were divided in their experience of teaching children with multiple disabilities. Preschool teachers from Italy stand out (M=2.92), who consider themselves to have a medium level of experience in teaching this population. However, preschool teachers from other countries still felt that they had no experience of this kind (1.09≤M≤2.00) (Figure 2).

Teachers' affinity to science, technology, math and art

Preschool teachers in most countries rated themselves as having a medium affinity for teaching science (2.17≤M≤3.76), technology (2.26≤M≤3.62) and mathematics (2.91≤M≤3.91). Spanish teachers, on the other hand, show a high affinity in these areas (science and technology: 4.26; mathematics: 4.16). Preschool teachers from all countries show a slightly higher affinity for teaching the arts (3.14≤M≤4.19) (Figure 3).

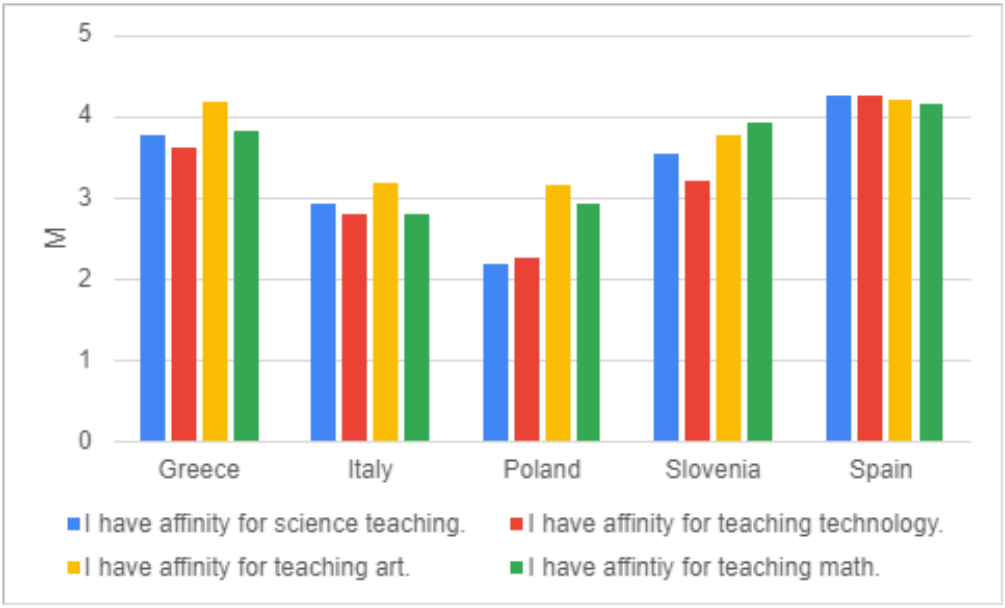

Figure 3 - Preschool teachers' affinity for teaching each subject area (1 – I do not have affinity; 5 – I have a lot of affinity) (mean value for each country).

Creating an inclusive learning environment

We looked at the extent to which preschool teachers understand and are prepared to meet the challenges posed by visual impairment (Figure 4).

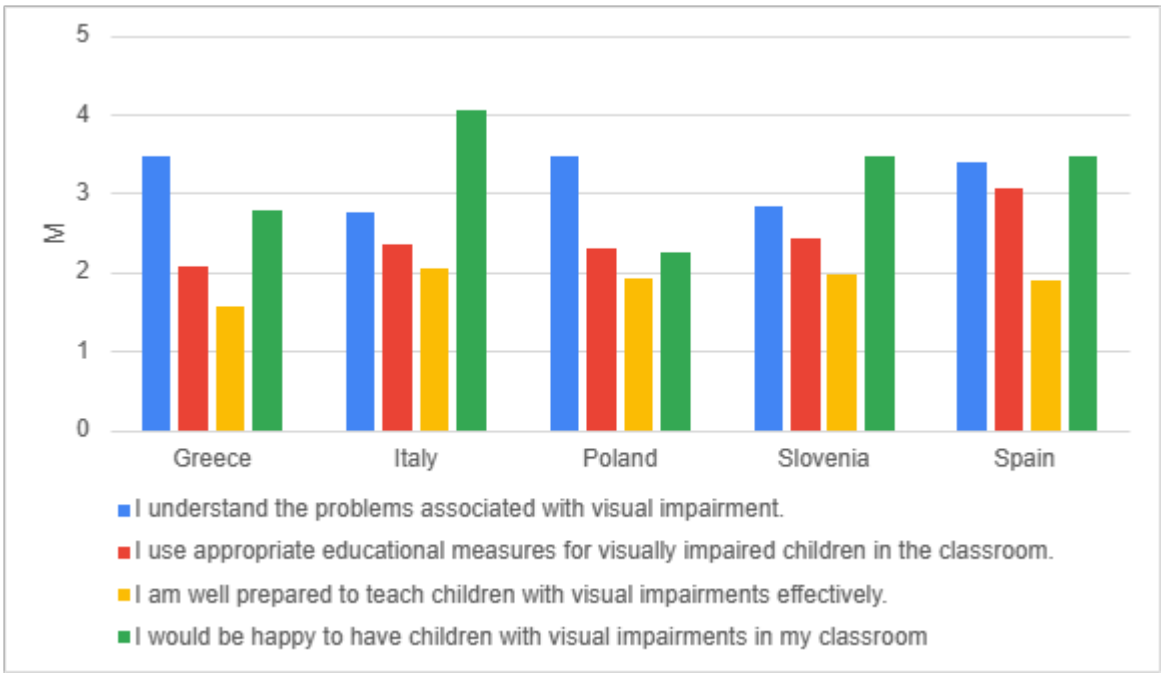

Figure 4 - Understanding and willingness to face the challenges of visual impairment (1- disagree; 5- strongly agree) (mean value for each country).

Preschool teachers are generally neutral in their understanding of the problems associated with visual impairment (2.77≤M≤3.47). Preschool teachers in most countries Greece, Italy, Poland, Slovenia, (2.06≤M≤2.43) do not think that they are able to adapt the learning process to children with visual impairment, while preschool teachers in Spain (M=3.06) express a neutral view. It is therefore not surprising that preschool teachers from Italy (M=4.05) would be happy to have a child with a visual impairment in their group. Preschool teachers from Greece, Slovenia and Spain were neutral (2.79≤M≤4.48), while preschool teachers from Poland (M=2.26) expressed no preference for including children with visual impairment in their group.

According to the participating preschool teachers, the inclusion of a child with a visual impairment among sighted peers would contribute positively to the learning, social and emotional domains (Table 2).

Table 2: Responses to the question: 'How much (what) do you think your peers would gain from a child with a visual impairment? Please explain your answer." for each country (f %)

	Greece	Italy	Poland	Slovenia	Spain
empathy	38.24	5.66	29.03	21.05	19.23
diversity of needs	**44.12**	15.09	**35.48**	**63.16**	**46.15**
tolerance	0.00	0.00	9.68	26.32	7.69
sensitivity	2.94	7.55	12.90	0.00	0.00
I have no opinion	0.00	1.89	9.68	0.00	0.00
self-help	0.00	0.00	6.45	0.00	0.00
learning from each other	0.00	7.55	19.35	15.8	26.92
understanding	0.00	1.89	3.23	10.5	0.00
not a lot of benefit	0.00	0.00	3.23	0.00	0.00
benefit a lot	17.65	**49.06**	3.23	0.00	7.69
acceptancy	8.82	0.00	3.23	5.26	3.85
aware of the existence of others	0.00	0.00	3.23	0.0	0.00
respect	2.94	0.00	0.00	10.45	7.69
collaboration	5.88	0.00	0.00	0.00	11.54
generous	0.00	0.00	0.00	0.00	3.85
resilience	0.00	0.00	0.00	0.00	3.85
patience	2.94	0.00	0.00	0.00	0.00
emotional intelligence	2.94	0.00	0.00	0.00	0.00
solidarity	5.88	0.00	0.00	0.00	0.00
responsibility	2.94	0.00	0.00	0.00	0.00
new technologies	2.94	0.00	0.00	0.00	0.00
adaptivity	2.94	0.00	0.00	0.00	0.00
dealing with problems	2.94	0.00	0.00	0.00	0.00
trust	2.94	0.00	0.00	5.26	0.00
interaction	0.00	0.00	0.00	5.26	0.00
new knowledge and skills	0.00	0.00	0.00	15.79	0.00
lifelong learning	0.00	0.00	0.00	5.26	0.00
humanity	0.00	0.00	0.00	5.26	0.00
flexibility	0.00	0.00	0.00	5.26	0.00
education opportunities/growth	0.00	5.66	0.00	0.00	0.00
communicate	0.00	3.77	0.00	0.00	0.00
test the limits	0.00	1.89	0.00	0.00	0.00
use of other senses	0.00	5.66	0.00	0.00	0.00

STEAM approach (Environmental Education and VIP)

The majority of Greek preschool teachers believe that the STEAM approach helps children to develop critical (29.41 %) and creative thinking (20.59 %), teamwork (29.41 %) and problem-solving skills (20.59 %) (Table 3). Italian preschool teachers consider the STEAM approach important to develop creativity (26.67 %) and critical thinking (16.67 %) and fine motor skills (15.00 %). As many as 21.21 % of Polish preschool teachers were unable to identify the most important skills acquired through the STEAM approach. A slightly smaller proportion of preschool teachers (18.18 %) highlighted independent research (Table 3).

Table 3: Responses to the question: In your opinion, which are the 3 most important skills that can be developed in STEAM (Science Technology Engineering Art Mathematics) education in kindergarten? "(f % for each country).

	Greece	Italy	Poland	Slovenia	Spain
creativity, creative thinking	20.59	**26.67**	9.09	12.50	**13.33**
curiosity	0.00	6.67	3.00	0.0	6.67
critical thinking	**29.41**	16.67	6.06	**18.75**	10.00
problem-solving	20.59	11.67	12.12	12.50	10.00
teamwork, cooperation	**29.41**	10.0	12.12	12.50	**13.33**
social skills, communication	17.65	5.00	9.09	15.63	10.0
fine motor skills	8.82	15.00	0.00	6.25	0.00
greater motivation to learn	2.94	0.00	3.03	3.13	3.33
observation	5.88	8.33	0.00	3.13	**13.3**
technological and digital literacy	17.6	10.0	0.00	6.25	6.67
space orientation	8.82	3.33	0.00	3.13	6.67
practical skills	2.94	0.00	12.12	3.13	3.33
independent inquiry	0.00	5.00	18.18	**18.75**	6.67
self-trust, self-sufficiency	0.00	1.67	9.09	6.25	0.00
connecting different areas	0.00	6.67	0.00	15.63	3.33

I do not know	8.82	10.0	**21.21**	12.50	3.33

The following question was designed to find out what preschool teachers consider to be the three most common challenges they face when integrating the STEAM approach in teaching children with visual impairments.

As seen in Table 4, the majority of preschool teachers highlighted adaptations of the teaching process and didactic materials. In addition, they also highlighted: motivation, lack of knowledge and professional support, cooperation, and the implementation of research and experimental work. However, a large proportion of teachers were not able to identify the most common challenges they face when integrating the STEAM approach for VIP.

Table 4: Responses to the question: "In your opinion, what are the three most common challenges that preschool teachers face when integrating the STEAM approach in the education of VIP?" (f % for each country).

	Greece	Italy	Poland	Slovenia	Spain
adaptation of the teaching process and materials	**20.59**	**51.16**	**45.45**	**70.83**	**47.62**
repetitions	2.94	0.00	4.55	0.00	0.00
motivation	2.94	0.00	**22.73**	0.00	4.76
lack of knowledge	5.88	**2.33**	0.00	4.17	**23.81**
cooperation	14.71	0.00	4.55	0.00	0.00
I do not know	**29.41**	**18.60**	**36.36**	**20.83**	**9.52**
lack of specialist	2.94	0.00	13.64	0.00	0.00
safety	0.00	0.00	0.00	4.17	0.00
no challenges	2.94	0.00	9.09	0.00	0.00
space limitations	5.88	0.00	4.55	**12.50**	0.00
lack of time	0.00	**2.33**	0.00	4.17	0.00
inquiry learning, experiments	**17.65**	0.00	9.09	0.00	**9.52**
real-world solving problems	2.94	0.00	0.00	4.17	0.00

Table 5 shows which environmental topics preschool teachers most often integrate into their kindergarten activities.

Table 5: Responses to the question: "List at least two environmental topics that you include in your kindergarten activities." (f % for each country).

	Greece	Italy	Poland	Slovenia	Spain
waste sorting, recycling	**85.29**	**26.67**	**100.00**	**40.63**	**53.33**
water and energy management	11.76	10.00	**54.55**	15.63	10.00
renewable energy source	11.76	1.67	6.06	3.13	10.00
biodiversity	2.94	**16.67**	9.09	21.88	10.00
environmental protection	5.88	**15.00**	**39.39**	**25.00**	**23.33**
gardening, plant life cycle	8.82	5.00	6.06	15.63	3.33
environmental pollution	**29.41**	6.67	15.15	**25.00**	10.00
water cycle	17.65	1.67	0.00	18.75	10.00
forest protection	11.76	10.00	0.00	3.13	10.00
climate change/global warming	**29.41**	13.33	0.00	0.00	6.67
endangered and protected species	11.76	0.00	0.00	3.13	3.33

In all countries, preschool teachers integrate the topic of waste separation and recycling into the teaching of environmental topics. Among them, we would highlight the answers of Polish teachers, as all respondents integrate this topic into pre-school education. The most frequently mentioned topics are environmental protection and pollution, learning about biodiversity, climate change, water and energy management (Table 5).

Table 6 presents the most common challenges that preschool teachers face when integrating environmental education for VIP.

Table 6: Responses to the question: "In your opinion, which are the 3 most common challenges to implementing EE (Environmental Education) topics in kindergarten for children with VIP?" (f % for each country).

	Greece	Italy	Poland	Slovenia	Spain
I don't know	**18.18**	7.89	**37.50**	16.67	**25.00**
experiments, use of real materials	**18.18**	18.42	6.25	25.00	5.00
outdoor learning challenges	15.15	10.53	0.00	4.17	5.00
adaptations	6.06	**42.11**	25.00	**33.33**	10.00
lack of time	0.00	0.00	6.25	0.00	10.00
teacher experiences, lack of knowledge	9.09	7.89	6.25	0.00	15.00
lack of teaching tools and materials	3.03	0.00	31.25	4.17	5.00
lack of staff	0.00	0.00	6.25	4.17	5.00
sensory and mobility limitations	3.03	0.00	0.00	4.17	10.00
safety	3.03	0.00	0.00	20.83	0.00
space limitations	0.00	0.00	0.00	16.67	0.00
organisation difficulties	0.00	0.00	6.25	0.00	0.00
no challenges	0.00	7.89	12.50	4.10	0.00

Greek, Polish and Spanish preschool teachers were largely unaware of the most common challenges in integrating environmental education for children with visual impairment. Italian and Slovenian preschool teachers mostly highlighted the necessary adaptations for this type of teaching. They also found it difficult to carry out experimental work and outdoor lessons, the lack of adapted teaching aids and safety. However, a few Italian, Polish and Slovenian preschool teachers do not see any challenges for this type of teaching (Table 6).

Next, we wanted to find out how often preschool teachers use each teaching approach in their work (Table 7). In most countries, preschool teachers most often integrate multisensory learning into their teaching. In Slovenia, however, they place more emphasis on creative and exploratory didactic games (Table 7).

This was followed by a question on the safety of STEAM activities for VIP. Preschool teachers in all countries considered that activities based on the STEAM approach are safe for children with visual impairment (3.56≤M≤4.10).

Table 7: Responses to the question:" How often do you include the following approaches in your activities (1 - never; 5 - very often)?" (Mean value for each country)

	Greece	**Italy**	**Poland**	**Slovenia**	**Spain**
experiential learning	3.79	4.25	4.30	4.00	**4.37**
multisensory learning	4.24	4.41	4.24	3.97	**4.63**
outdoor learning	3.74	4.27	4.18	3.84	**4.40**
creativity games and experimental games	3.91	3.97	4.03	**4.13**	4.05
use of computer science and/or robotics in activities	3.53	3.62	3.79	3.13	**4.03**
interdisciplinary projects (integration of different areas of STEAM)	3.79	3.44	3.82	3.53	**4.43**
visits to science centres, botanical gardens, zoos, museums	3.53	3.95	4.15	2.26	**4.33**

In addition, we were interested in teachers' opinions about environmental education for VIP (Table 8).

Table 8: Teachers' agreement with each statement (1- strongly disagree; 5- strongly agree) for each country (mean value for each country)

	Greece	Italy	Poland	Slovenia	Spain
I think environmental education is also important for children with VI.	3.59	4.62	3.56	4.47	**4.73**
Environmental education in early childhood is a crucial time for the development of environmental literacy in children with visual impairment.	4.44	4.47	4.17	4.28	**4.77**
For children with VI, positive childhood experiences in nature are associated with the emergence of adult environmental behaviours.	4.47	4.33	4.51	4.41	**4.72**
I teach environmental education topics to children with VIP very often.	1.76	2.29	1.63	**3.78**	2.59
I have adequate knowledge about how to teach preschool environmental education topics to children with visual impairment.	1.74	2.07	1.79	2.03	**2.52**
I understand how to integrate environmental education topics into a curricular content area.	**3.91**	3.49	2.86	2.16	3.76
I need further professional development to implement my skills in teaching environmental education topics to children with visual impairments.	4.06	4.19	3.91	**4.47**	4.07

The results show that teachers feel that they do not have enough knowledge and experience to teach environmental education to children with visual impairments. In addition, they do not feel that they have a good understanding of how to integrate environmental education topics into the curriculum areas. Most of them consider that the preschool period is crucial for developing environmental literacy for children with visual impairment.

We followed up with a question concerning the assessment of the competences of teachers to integrate STEAM concepts in the education of children with visual impairment. Preschool teachers in all countries rated themselves as having no or very little competence to integrate STEAM concepts ($1.71 \leq M \leq 2.28$).

Skills needs for working with children with visual impairment

Below we present the results of the responses concerning the knowledge needs of the interviewed preschool teachers for working with children with visual impairment.

Initially, we were interested in whether the respondents felt that they needed more knowledge about visual impairment. Their answers showed that preschool teachers from most countries think they need more knowledge about visual impairment (3.59≤M≤4.50), while professionals from Slovenia think (M=4.63) that they need this kind of knowledge very much.

In addition to basic knowledge, we were also interested in which areas of child development they would need more knowledge. The results are shown in Figure 5.

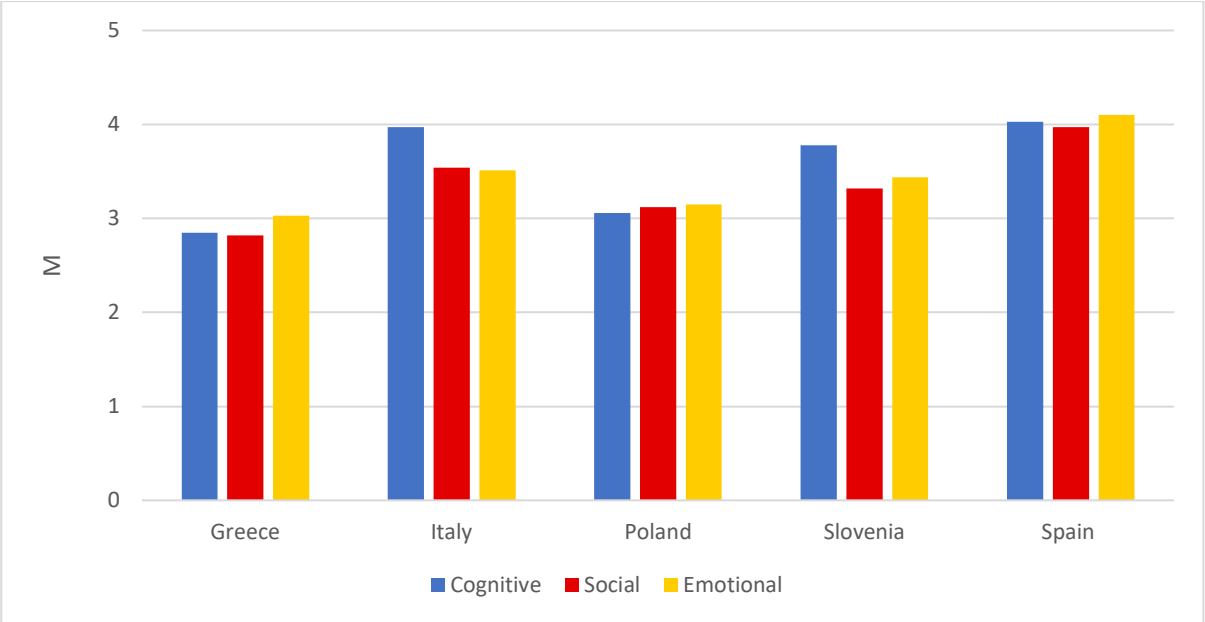

Figure 5 - Knowledge needs by area of development for children with visual impairment (mean value for each country)

Spanish preschool teachers think that they need more knowledge in all areas of the development of a child with visual impairment, and in addition to Spanish preschool teachers (M=4.03), preschool teachers from Slovenia (M=3.78) and Italy (M=3.97) would need more knowledge in the area of cognitive development.

Using digital technology in kindergarten

The last set of questions concerned the use of digital technology in kindergartens.

The first question was designed to find out if respondents use digital technology to teach children aged three to five years.

The results showed that the Polish preschool teachers (M=2.4) consider that they have limited knowledge of the use of digital technology for teaching children aged three to five years, while the

remaining preschool teachers (M=2.4) are undecided about their knowledge of digital technology for this age group (2.57≤M≤3.29).

It turns out that preschool teachers are less likely to use digital technology in their work. The responses were grouped into three categories: hardware, software and internet tools. The most commonly used devices (hardware) are: tablet, computer, telephone, projector educational robots, 3D pen and interactive whiteboard. They are most commonly used in Slovenia, followed by Spain, Greece, Italy and Poland (Table 9).

Table 9: Examples of digital technology in kindergarten (f % for each country)

	Greece	**Italy**	**Poland**	**Slovenia**	**Spain**
hardware	64.71	40.00	3.03	100.00	70.00
software	8.82	13.33	0.00	43.75	33.33
internet tools	0.00	1.67	0.00	6.25	6.67

The most commonly used software in kindergartens are various applications (Canva, Makeymakey, Zoom...), virtual reality, digital games and storytelling. Software tools are also the most frequently used tools by preschool teachers in Slovenia, followed by preschool teachers in Spain, Italy and Greece (Table 9). Preschool teachers in Poland do not use such tools. The use of other internet tools is minimal in all countries (0≤F≤2).

We also checked whether they know and use assistive digital technology for children with visual impairments. When answering this question, preschool teachers in all countries were unanimous in their knowledge or limited knowledge of assistive technology for teaching children with visual impairments aged 3-5 years. Examples of assistive digital technology given were generic digital tools that are not exclusively designed for teaching children with visual impairments.


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5. Conclusions and Recommendations for the Development of TTC and Toolbox

Every child with visual impairment has the potential to use his or her vision in efficient ways and can learn and reach their potential if the learning process and materials are accessible and adapted. Each child with a visual impairment function in his or her own unique way. The adjustments to the learning process are highly individualised or personalised according to visual functioning. It is desirable that each child with a visual impairment undergoes a visual functioning assessment, and on the basis of this we determine the exact adjustments to be made in an individualised programme.

To enhance the educational experience of Visually Impaired Pupils (VIP) in Science, Technology, Engineering, Arts, and Mathematics (STEAM) it is recommended that Teacher Training Courses (TTC) and Toolbox be developed with the following considerations:

Space Adjustment: The learning environment should be safe and accessible for VIP, with physical barriers removed and clear paths for movement. Classroom layouts should be consistent to aid independent navigation. Tactile floor markers and other adaptations can be used to help VIP orient themselves. Classroom furniture, as indicated for the centre, must be adapted to the possibilities of visually impaired students (accessibility, operability, ergonomics and availability).

Adaptation of Didactic Materials: Teaching materials should be adapted to meet the needs of VIP. Offer tactile pictures, enlarged pictures or images as well as enlarged, Braille texts or texts adapted for children with CVI, allow the child to work at close distances, move the child closer to the object (the object can also be moved closer to the student) and invite people to move closer when talking. Adapted materials include also use of real objects, embossed representations of real objects, tactile materials like dough or clay, and kinaesthetic activities. Digital resources should be compatible with screen readers and Braille display devices. Work in cooperative groups can be ideal didactic and organisational strategies for educational intervention, so that the required visual skills are shared or assumed by other classmates.

Special Equipment, Digital Technology, Use of Assistive Technologies: Use of assistive technology such as digital Braille devices, magnification software, text-to-speech tools, mathematical instruments with Braille readings, and special computers is crucial. Further, 3D printers can be used to produce tactile material. Text-to-speech systems, digital talking books, and devices presenting haptic and auditory information simultaneously can enhance the learning of a blind or low vision

student. For children with CVI, there are a number of apps available for phone or tablet to make it easier for them to watch and follow the learning process.

Staff Training: Training of professionals is a key part of the successful integration of children with visual impairment into the group. On the one hand, training should focus on understanding individual visual impairments and the adaptations that result from them, and on the other hand, focus on the STEAM approach. Preschool teachers should receive training on how to make STEAM subjects accessible to VIP. This includes understanding the use of assistive technology, creating inclusive lesson plans, and adapting materials for VIP. Preschool teachers should also be trained in the use of audio narratives, tactile exhibits, and models.

Collaboration and Parental Engagement: Collaboration between general and special education teachers is encouraged. Regular consultations with specialists can provide valuable insights. Parents should also be involved in the learning process, as they spend the most time with the child and their observations are just as valuable.

Continuous Evaluation: Regular assessment of the effectiveness of the adaptations and technologies being used is necessary. This can help identify areas that need improvement and ensure that the learning needs of VIP are being met effectively.

Experiential Learning: Organise visits to places that emphasise inclusion, such as the Athens Olympic Museum, which offers a multisensory tour for all.

With the appropriate equipment, teacher training, and spatial transformation, the conditions can be created for the organisation of STEAM activities that are suitable for VIP and their inclusion in general education schools. The implementation of these recommendations can significantly enhance the educational opportunities available to VIP.

To sum up, according to the findings of the GREEN4VIP online survey for pre-school teachers, it will be necessary that the GREEN4VIP teacher Training Curriculum developed in WP3 will cover, among others, the following topics:

- → Overview on the different types of visual impairments so that pre-school teachers are aware of the difference between a blind child and a child with partial sight/low vision as well as their different implications on the child cognitive and emotional learning process;
- → Information on the different available digital technologies to be used with kids aged 3-5 in kindergartens as well as specific assistive technologies which can be used with visually impaired pupils;

→ Competences on how to integrate the STEAM concepts with classes attended visually impaired pupils;

→ Competences on how to convey environmental education topics to kids with visual impairment, in particular for what concerns how to adapt the activities/games and the didactic materials.

For the GREEN4VIP Inclusive Toolbox for VIP which will be developed in WP4, the following issues have to be taken into consideration while designing the workshops' activities:

1) Space adjustment to facilitate the VIP orientation and mobility;
2) Use of adapted teaching aids / materials (tactile books for kids, audio books, 3d or real objects, use of different textures, Braille or large print documents / labels, etc)
3) Implementation of accessible and inclusive activities / games for VIP too. At last, do not forget that all activities should be safe for all kids, including VIP! Keep it in mind when designing your workshops!

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