Fostering STEAM for Inclusive Learning

Miguel Á. Conde [1,2], Francisco J. Rodríguez-Sedano[1], José Gonçalves[3] and Francisco José García-Peñalvo[4]

[1] *University of León, Escuela de Ingenierías – Campus de Vegazana S/N, León, 24071, Spain*
[2] *Universidad de Salamanca, Escuela Politécnica Superior de Zamora – Av. de Requejo, 34, 49029 Zamora, Spain.*
[3] *Politechnic Institute of Bragança, CeDRI - Research Center for Digitalization and Intelligent Robotics SusTEC - Associate Laboratory for Sustainability and Technology in Mountains Regions, Bragança, Portugal*
[4] *Universidad de Salamanca, Facultad de Ciencias – Plaza de los Caídos S/N, 37008, Salamanca, Spain.*

Abstract

In contemporary society, there is a growing demand for professionals with the essential skills required in the 21st century. The STEAM (Science, Technology, Engineering, Arts, and Mathematics) disciplines have emerged as pivotal in facilitating the acquisition of these skills. Indeed, these disciplines have exhibited their capacity to enhance workforce performance and fortify a nation's innovation potential, emphasizing the critical need to promote STEAM education among students and integrate it into existing educational curricula. Nonetheless, the inclusion of students with intellectual or developmental disabilities (IDD) in these disciplines presents formidable challenges. These challenges can be attributed to prevailing low expectations regarding the potential of disabled individuals to excel in STEAM fields, the inaccessibility of STEAM education curricula, and the limitations that educators face in fully supporting the integration of students with disabilities. In response to these challenges, we introduce the RoboSTEAMSEN project. The principal objective of the RoboSTEAMSEN project is to bolster educational processes by equipping teachers working with students with IDD with methodologies and tools that employ Robotics and Active Learning Methodologies to promote STEAM education. The project's overarching goals encompass comprehending the specific needs of disabled students and adapting robotics and active learning techniques to accommodate various disabilities, designing comprehensive training programs for teachers to enable them to individualize the learning experiences of students with IDD, establishing a community of practice supported by a technological ecosystem that serves as a central hub for educators and decision-makers to engage in discourse on how to achieve success in STEAM education for IDD students.

The primary outcome of this project will be the enhancement of STEAM education for students with IDD. To achieve this objective, we will develop a taxonomy for the categorization of resources tailored to this demographic, institute a user model for personalized learning, generate guides, resources, and courses for teachers, formulate workshop models for the wider dissemination of project findings, and establish a technological ecosystem to facilitate a thriving community of practice dedicated to this important educational domain.

Keywords

STEAM Education, Inclusive Education, Disabled Students, IDD, Robotics, Active Learning Methodologies.

1. Introduction

We live in a technological society that is constantly changing, institutions and companies need to be prepared for the change, to obtain immediate feedback about what they are doing, publish their results,

Proceedings for the 14th International Conference on e-Learning 2023, September 28-19, 2023, Belgrade, Serbia
EMAIL: mcong@unileon.es (A. 1); fjrods@unileon.es (A. 2); goncalves@ipb.pt (A. 3); fgarcia@usal.es (A.4)
ORCID: 0000-0001-5881-7775 (A. 1); 0000-0001-5909-1566 (A. 2); 0000-0002-5499-1730 (A. 3); 0000-0001-9987-5584 (A. 4)


to interact with their stakeholders. This means that professionals, to succeed, should be ready to use new information sources, and new devices and to deal with new problems derived from such a technological landscape and the emergence of artificial intelligence [1]. This means that they must develop XXI century skills from an early age. Competences such as computational and critical thinking, problem-solving, collaboration, communication, and creativity [2].

The acquisition of such competencies used to be associated with STEAM (Science, Arts, Technology, Engineering, and Mathematics) education [3]. These disciplines have shown that they can lead to improved workers' performance and enhance countries' innovation capacities [4, 5], which makes it essential to foster young STEAM among students and also to facilitate integrating STEAM in current educational curricula. Several projects have dealt with this topic, such as TACCLE3 [6] or ROBOSTEAM [7]; and others have addressed STEAM as an inclusion chance of specific collectives, such as W-STEM [8] or CreaSTEAM [9].

However, a collective that must not be forgotten is disabled people. For them, access to STEAM disciplines is not easy [10] for several reasons, such as: the low expectations from others regarding disabled people's ability to succeed in STEAM; inaccessible STEAM education curriculum; and teachers' inability to fully support the inclusion of students with disabilities [11, 12]. To overcome this situation, it is necessary to look for the best approaches. In this sense, robotics could be an interesting option for promoting STEAM [13] it has been used successfully in SEN teaching especially to promote social skills and to improve executive functions [14]. However, the key factor is not only to apply robotics but also to adapt robotics for disabled people and the different kinds of disabilities [15]. This means supporting experts and teachers with specific/adapted robotic resources, methodologies, and tools for different types of disabilities.

Regarding this topic, a project with special relevance was RoboSTEAM 2018, which had as final results methodologies, assessment tools, and other resources to facilitate integrating STEAM and developing computational thinking using robotics and physical devices. The RoboSTEAM project also detected a gap regarding the use of robotics and active learning methodologies with this aim for disabled people [16]. With this problem in mind, part of the project team decided to help bridge such a gap by using robotics and active learning methodologies to facilitate access to STEAM education for people with IDD. ROBOSTEAMSEN will support SEN teachers for people with with intellectual or developmental disabilities (IDD) in STEAM education by providing adapted tools and techniques for different IDD. This requires understanding the most common IDD, their features, and personalizing learning with robotics and active learning methodologies to a great variety of SEN teaching activities. In this paper we are presenting and describing the project.

The rest of the paper is structured as follows; the next section includes a general description of the project, including the context, objectives, and partnership. Section 2 presents the project's work-packages and activities, and section 3 describes the expected outcomes and impact. Finally, some conclusions are posed.

2. Project description

2.1. Project context

A complete inclusion of people with IDD in our society is essential, and this can be addressed through the educational field. Just in the European Union (EU) there are 99 million people with disabilities, of whom 3% have intellectual disabilities [17]. Scholar education dropout for this collective depends on each country but could reach 60% [18]. It is necessary to improve these rates by engaging disabled students in education and personalizing their learning, which can be addressed using technology [19]. In addition, STEAM Education can also increase this collective employability, which used to be low 52% [20]. This requires training teachers in the use of ICT, as stated by the "Technology for Inclusion" UNESCO's study [21], and also in STEAM [11].

But what technology to choose? In this sense, the use of robotics and active learning methodologies has been quite successful in the field of STEAM education [16], so it is interesting to look for the same results with students with IDD.

However, a successful use of technology for fostering STEAM for people with IDD requires of an adaption of any resource or intervention because the heterogeneity of this collective in disabilities, severity levels, how the students are included in schools considering each country, their age, the time to spent in the learning activities, etc. For instance, it is not the same adaptation required by a child with autism mental disorder in level 1, who could be integrated into a regular school, could use technology but could have communication problems, that one person that has level 3 and would need a special school and has very different behavior. This means that the type of robotics, the methodologies, the contents, the interaction, and the characteristics of each learning activity can vary depending on students' features and context. So, adaptations are required, which means teaching the teachers to do this. Given this situation, we can assert that there are four primary necessities to address:

- The need for teachers to adapt STEAM education depends on the necessities of students with IDD, the severity levels, and the context where the learning activity is carried out. This means identifying an important number of settings to take into account in STEAM-related activities and clarifying to lecturers what type of adaptation can be required at each moment.
- The need of teachers for tools and knowledge to use them in the previously defined situation. Including both technical and methodological tools. From the technological point of view, it is possible to include different kinds of robots or physical devices that can be adapted to very heterogeneous situations and student features. Regarding the methodological point of view, it is possible to facilitate tools for conducting the learning activities, assessing the people with IDD, facilitating the acquisition of STEAM-related competencies for this collective, integrating the activities with regular curricula, etc.
- Teachers' needs to know how to personalize the learning activities for fostering and integrating STEAM for children with IDD by using the guides and tools previously mentioned.
- The need for a collaborative space for supporting teachers and caretakers of persons with IDD in using the resources provided in RoboSTEAMSEN beyond the project and even in applying them in other possible collectives or contexts.

RoboSTEAMSEN will define a knowledge base for training SEN teachers for people with IDD to foster STEAM and facilitate the development of computational thinking by using robots and active learning methodologies. It addresses the necessities above described in the following ways:

- Guiding teachers in the type of adaptations required for STEAM education. The project will define first a description and categorization of the different profiles of students with IDD in the field of STEAM Education attending to issues such as IDD, severity, student level, or age. With that, a study of the different types of resources to use is carried out, and a user model so it is possible to see what fits better with each situation and suggest how to proceed in the STEAM education activities.
- Providing teachers with tools that they can use in the previously defined situation. Compilation of possible tools to use includes technological solutions such as open hardware or software and pedagogical and methodological tools and instruments. These resources will be classified according to previously defined categorization, so it was possible to facilitate learning personalization.
- Teaching the teachers how to personalize the learning activities. Define training programs for supporting the teachers in the adaptation required for STEAM disciplines when dealing with students with IDD using robotics. RoboSTEAMSEN will provide one training program for each STEAM Disciplines and at least one considering an IDD. In addition, a general training program will be also provided.
- Developing a collaborative space for supporting the practice of STEAM Education for students with IDD. The project will develop and maintain an open virtual space in which all the target groups can exchange experiences, resources, doubts, etc. The environment will be disseminated throughout the partnership and associated partners and to other institutions related with the education of students with IDD.

2.2. Project objectives

Given the above-described context ROBOSTEAMSEN main objective is to support educational processes by providing teachers of students with IDD with methodologies and tools for fostering STEAM by using Robotics and Active Learning Methodologies.

This is aligned with several EU priorities. The aim of the EU through the Erasmus+ Programme is to "support, through lifelong learning, the educational, professional and personal development of people in education, training, youth, and sport". One of its key priorities is "INCLUSION AND DIVERSITY," looking to "promote equal opportunities and access, inclusion, diversity, and fairness across all its actions" and with several collectives to be considered, among them disabled people [22]. RoboSTEAMSEN project is completely aligned with this priority and collective, as it aims to define a knowledge base for training SEN teachers for people with IDD to foster STEAM and computational thinking using robots and active learning methodologies. This goal it is also aligned with some horizontal priorities:

- "Promoting interest and excellence in science, technology, engineering, and mathematics (STEM) and the STEAM." RoboSTEAMSEN will promote STEAM for children with IDD by providing personalized tools and techniques and building a community for teachers on this topic.
- "Supporting teachers, school leaders and other teaching professions." In this sense, RoboSTEAMSEN will support teachers by providing them with tools to carry out innovative teaching and develop adaptations for students with IDD and assessment tools and methods for them.
- The project's main objective can be articulated as several sub-objectives:
- Analyze and identify the different problems related to STEAM education and people with IDD.
- Analyze and identify possible methodological and tool adaptations required by students with IDD depending on the type and level of IDD in the context of robotics and active learning methodologies.
- Define application guides for personalizing robotics and active learning methodologies in STEAM Education for students with IDD, considering different possible disabilities and levels.
- Collect and publicly share good practices, contents, and tools to employ robotics in SEN teaching for STEAM Education.
- Conduct SEN teacher training and school workshops to spread the resources, methodologies, and adaptation knowledge to guarantee integrating STEAM for people with IDD.
- Establish ways of collaboration between robotics labs at universities, robotic companies, and Educational Institutions for people with IDD.

2.3. Partnership

The partnership consists of eight organizations, including four Higher education Institutions, two regular schools, one school for SEN students, and a technical partner. The universities are Universidad de León (ULE), Instituto Politécnico de Bragança (IPB), University of Eastern Finland University (UEF); and Universidad de Salamanca (USAL). The schools are: Colégio Internato dos Carvalhos (CIC) and EuroEd (EED). The special needs school is CEE Nuestra Señora del Sagrado Corazón (SCO). It should be pointed out that the UEF will participate in the project also as a school because this institution, represented by the same PIC, includes both the university and primary and secondary schools. This means it will participate in these two ways.

The composition of the consortium is mainly based on the partners' main fields of expertise, educational robotics and school education, and on the synergies created during previous collaborations, especially for many of them during the RoboSTEAM project. ULE is the coordinator of the project.

Regarding the expertise, on the one hand, ULE and IPB have broad experience researching robotics and how they are applied in educational contexts. On the other hand, USAL and UEF are specialized in teacher education, eLearning, and STEAM integration. UEF school and EuroEd have been involved in several Erasmus projects, and both, together with CIC, develop learning programs related to technological issues. SCO specializes in SEN education and, more specifically students with IDD. Pixel has been involved in technical tasks of more than 150 projects. Moreover, several partners have worked together on different projects. USAL has collaborated with UEF in the TACCLE 3 project; USAL and

ULE have published different papers related to Robotics, Education, and Software Engineering; ULE, IPB, and USAL have worked together in the Intensive Program Entrepreneurship Education for European Students (E3S); ULE, USAL, IPB, UEF and CIC have worked in the RoboSTEAM project; IPB has worked with CIC in several local projects as ULE with SCO; Pixel and EuroEd have worked together in several Erasmus projects.

Each university partner leads a network of schools (usually involved in their activities, particularly, in-service, and future teachers training), and the schools involved also have a contact network that includes several educational institutions. In addition, the partnership includes as associated partners several associations for people with IDD. This means that the consortium can reach out to the school's context at the national and regional levels. At least 45 associated partners will be involved from the beginning of the project. It should also be noted that with this partnership, we are involving countries with different socio-economic situations, something necessary to test how the outputs of the project are applicable in different contexts and if the adaptations proposed work properly in these different situations.

3. Project work packages and activities

The goals of the project will be achieved through 5 work-packages. These are:

- WP1. Project Management. This work package is essential in every project. It includes operational and financial management of the project, the risk management approach, the quality management, and the communication strategy. During the Kick-off Meeting, a Steering Project Management Committee (formed by the contact person of each institution) will be defined and will lead a participatory process to ensure that all previous processes are completed properly.
- WP2. Adapting Resources, Methodologies, and Tools by IDD. This WP is defined to provide the knowledge to facilitate adapting robotics and active learning methodologies for different IDD. To achieve so, it is articulated in the following activities:
  - WP2.T1. Analysis and extraction of the main features to be considered to classify students with IDD. ThisThis task aims to understand the main issues to take into account to define a taxonomy in the next activity.
  - WP2.T2. Definition of a taxonomy for classifying disabled students based on WP2.T1 features. This means identifying the different taxon and validating how they can be used in the classification of students.
  - WP2.T3. Definition of a user model for personalizing learning in STEAM. It will consider the different disciplines and the features of the students. ULE will lead this package with equal collaboration with the rest of the partners.
  - WP2.T4. Compilation of robotics and methodological resources and instruments. They will be employed to adapt interventions depending on the users' needs expressed by the user model.
  - WP2.T5. Definition of case scenarios for the adaptation of interventions.
  - WP3.T6. Validation of the case scenarios, taxonomy, and user model. It requires expert collaboration.
  - WP3.T7. Definition of guides and samples for personalizing STEAM education for students with IDD, based on the previous results.
  - WP3.T8. Transnational Project Meeting.
- WP3. Teacher Training Package. In WP2, several tools and resources were defined to support the teachers' interventions in STEAM Education for students with IDD. However, it is necessary to train teachers into using these new guides and tools. To do so, this work package includes the following tasks:
  - WP3.T1. Design of training programs and materials. ThisThis task is to define training programs, one per STEAM discipline of at least two levels. In addition, one training program will be specifically designed for a specific IDD. To define these programs, it is necessary to consider the best materials for each situation.

- WP3.T2. Implementation of training programs as courses and deployment in an LMS. The training will be conducted online, so the training programs should be implemented as online courses and deployed in one or several LMS.
- WP3.T3. Teacher training. Teachers from the schools will be trained in the programs defined by the consortium. This training will be online and follow a project-based learning approach where the students will collaborate using online tools.
- WP3.T4. Definition of workshops for future training. Production of templates and contents for online and face-to-face workshops to take place in the associated patterns institutions and other related with the consortium contact networks.
- WP3.T5. Transnational Project Meeting. This task aims to coordinate the WP activities and content production.

- WP4. Technical ecosystem & Community of practice. One of the main problems of projects such as RoboSTEAMSEN is to spread the result and be able to maintain it after the project is finished. To address it, WP4 aims to create a community of practice supported by a technical ecosystem. This is developed through the following tasks:
  - WP4.T1. Design and implementation of the technological ecosystem. It is necessary to define a virtual environment that provides functionalities such as a web portal, user management, news system, social networks, collaboration tools, repository, and access to the LMS.
  - WP4.T2. Validation of the technical ecosystem by experts and end users. It is required to guarantee a good performance of the different tools.
  - WP4.T3. Collection of resources to be included in the ecosystem repository. Compilation, classification, and curation of resources about STEAM Education for students with IDD.
  - WP4.T4. Definition of User manual and tutorials. Creation of multimedia content about the use of the ecosystem and two documents for guiding both the administrators and the end users.
  - WP4.T5. Engagement of end users. Elaboration of communication and engagement plans to spread the use of the community.
  - WP4.T6. Transnational project meeting. Meeting to check the progress of these and other work packages.
- WP5. Dissemination and exploitation. For any project, it is necessary to have widespread results. This work package aims to make sure that the project partnership is committed to ensuring appropriate dissemination and exploitation measures aiming at guaranteeing the project the maximum visibility, creating the condition for its sustainability in time and multiplying the impact of its deliverables and outcomes in the educational sector at large.

4. Project expected results

The expected project results aim to address the objectives defined in section 2. They can be summarized as:

- Guidelines for SEN teachers on addressing STEAM Education from a pedagogical perspective considering different types of IDD.
- Database of teaching contents organized by IDD. Collection of Tools, Training Contents, and Possible Learning Actions to use for fostering STEAM by using active methodologies and robotics.
- Developing training programs for SEN teachers for fostering STEAM by using active methodologies and robotics.
- PR4.Community of practice – Experts and teachers' virtual ecosystem to meet up and share their expertise.

They are developed during the different work packages. With more detail, the expected results of each work package are:

- WP1. Management:
  - Project Management Handbook.
  - Project Grant Agreement with the Spanish Agency.

- Project Bilateral Agreements between the coordinator and the partners.
- Quality plan that includes the internal quality assurance processes.
- Quality reports in months 12 and 24.
- Risk Management Approach.

- WP2. Adapting Resources, Methodologies, and Tools by IDD. This result to defines a knowledge-basedbase about IDD. More specifically, the expected results are:
  - A Taxonomy to describe the features of students with IDD. With this taxonomy, it would be possible to classify educational resources by disability, severity level, etc.
  - A user model based on the previously defined taxonomy, so it was possible to represent the concrete needs of the students attending to their disabilities.
  - A set of resources and tools for STEAM Education. Compilation of robotics solutions and methodological tools will be classified using the taxonomy for later producing intervention adaptations in STEAM disciplines personalized for each student's disability.
  - Guides for using the user model and the repository of resources in real intervention adaptation. The teacher should be able to characterize a student using the user model and later look into the repository for resources that fit students' needs.
  - Samples of interventions adapted to the most common scenarios regarding IDD and students' needs for specific STEAM disciplines.
- WP3. Teacher Training Package. This WP will produce several results. Some of them are related to the teachers training in the use of guides, tools, and resources produced during WP2 to facilitate learning adaptations to accomplish the needs of students with IDD in the field of STEAM. In addition, this WP will produce content for workshops to be carried out in other institutions beyond the partnership that can be useful for training teachers from the associated partners. More specifically, the expected results are:
  - One training program for each specific STEAM discipline.
  - One training program for a specific disability.
  - Several online courses to implement the training programs.
  - Templates to generate content for future training programs.
  - Workshop content to train teachers in the project results.
- WP4. Technical ecosystem & Community of practice. The results related to these WP are based on the technical solution and how it can be used and maintained. The idea of having a community of practice requires several tools, and in this case, the WP will provide a technological ecosystem to facilitate the collaboration of interested stakeholders. To do so, several outcomes will be produced:
  - The design and implementation reports for the definition of the technological ecosystem.
  - Technological Ecosystem that includes tools for managing different types of profiles, tools for collaboration and interaction, and a repository for publishing resources related to the project (produced during the project but also from other sources).
  - User Manual and tutorials for using the ecosystem, including a collection of multimedia and a complete user manual.
  - Initial resources compilation to be included in the repository.
  - Engaged Users. To guarantee building a community of practice that will extend the project's sustainability, it is necessary to involve stakeholders interested in the topic.
- WP5. Dissemination and exploitation. The full implementation of the work package activities ensures the achievement of the following results:
  - The organization of specific events, one in each country, dedicated to multiplying the impact of the project.
  - Project target groups and beneficiaries are fully informed about the project achievements and deliverables.
  - Creation of the conditions for the project outputs being used and sustainable in time.
  - The project will be presented at national and international conferences to its achievements.
  - Involvement of other institutions in charge of education in further promoting the information about the project to their end users.

- Key policy and decision-makers in education and training are aware of the project's activities, deliverables, and results to enhance their mainstreaming at a systemic level.
- Availability of web links from websites specialized in education and training towards the project web portal.
- Media promoting the publication of information about the project.

5. Conclusions

Integrating individuals with Intellectual and Developmental Disabilities (IDD) into the labor force represents a formidable challenge that demands focused attention. Previous research has anticipated that STEAM education and robotics will offer valuable support for this endeavor. ROBOSTEAMSEN project has been designed to catalyze such training initiatives.

The core objective of ROBOSTEAMSEN is to establish a robust knowledge-based framework, tailored training programs, and a community of practice devoted to the pedagogy of STEAM for students with IDD. The project approach considers the unique characteristics of these students, the available resources, effective implementation strategies, and robust methods for outcome assessment. By bringing together a diverse array of researchers and educators with a shared interest in this domain, we aim to unearth the most effective solutions for students with IDD.

Acknowledging the inherent complexity in addressing the diverse spectrum of IDD conditions and their corresponding interventions is important. As an initial step, we are laying the foundation for a knowledge database prioritizing the most prevalent conditions. We envision this resource as a stepping stone, with future plans to expand its scope to embrace a broader range of conditions, further advancing the cause of inclusive learning.

6. Acknowledgments

This work is partially supported by the Erasmus+ Project "ROBOSTEAMSEN – Training SEN teachers to use robotics for fostering STEAM and develop computational thinking" with ref: 2023-1-ES01-KA220-SCH-000155379 granted by the call Cooperation partnerships in school education KA220-SCH.

7. References

[1] F. J. García-Peñalvo, F. Llorens-Largo, and J. Vidal, "The new reality of education in the face of advances in generative artificial intelligence.," *RIED: revista iberoamericana de educación a distancia,* vol. 27, no. 1, 2024. [Online]. Available: https://doi.org/10.5944/ried.27.1.

[2] M. Á. Conde *et al.*, "RoboSTEAM Project: Integrating STEAM and Computational Thinking Development by Using Robotics and Physical Devices," in *Information Technology Trends for a Global and Interdisciplinary Research Community*, J. G.-P. Francisco Ed. Hershey, PA, USA: IGI Global, 2021, pp. 157-174.

[3] M. S. Ramírez-Montoya, Ed. *Handbook of Research on Driving STEM Learning With Educational Technologies* (Advances in Educational Technologies and Instructional Design (AETID). Hershey PA, USA: IGI Global, 2017.

[4] F. J. García-Peñalvo, "A brief introduction to TACCLE 3 – Coding European Project," in *2016 International Symposium on Computers in Education (SIIE 16)*, F. J. García-Peñalvo and J. A. Mendes Eds. USA: IEEE, 2016.

[5] Comisión Europea/EACEA/Eurydice, *El Espacio Europeo de Educación Superior en 2015: Informe sobre la implantación del Proceso de Bolonia*, Luxemburgo: Oficina de Publicaciones de la Unión Europea, 2015. [Online]. Available: https://goo.gl/zUDrdu.

[6] TACCLE 3 Consortium. "TACCLE 3: Coding Erasmus + Project website." https://goo.gl/f4QZUA (accessed.

[7] C. Fernández Llamas and M. Á. Conde González, "RoboSTEAM Project," 2019. Accessed: February. [Online]. Available: https://doi.org/10.5281/zenodo.2575066

[8] A. García-Holgado and F. J. García-Peñalvo, "A model for bridging the gender gap in STEM in higher education institutions," in *Women in STEM in Higher Education: Good Practices of Attraction, Access and Retainment in Higher Education*: Springer Nature Singapore Singapore, 2022, pp. 1-19.

[9] D. Amo *et al.*, "CreaSTEAM. Towards the improvement of diversity gaps through the compilation of projects, best practices and STEAM-Lab spaces," presented at the Ninth International Conference on Technological Ecosystems for Enhancing Multiculturality (TEEM'21), Barcelona, Spain, 2021. [Online]. Available: https://doi.org/10.1145/3486011.3486426.

[10] C. Dunn, K. S. Rabren, S. L. Taylor, and C. K. Dotson, "Assisting Students With High-Incidence Disabilities to Pursue Careers in Science, Technology, Engineering, and Mathematics," *Intervention in School and Clinic,* vol. 48, no. 1, pp. 47-54, 2012, doi: 10.1177/1053451212443151.

[11] D.-L. Lamptey, E. Cagliostro, D. Srikanthan, S. Hong, S. Dief, and S. Lindsay, "Assessing the Impact of an Adapted Robotics Programme on Interest in Science, Technology, Engineering and Mathematics (STEM) among Children with Disabilities," *International Journal of Disability, Development and Education,* vol. 68, no. 1, pp. 62-77, 2021/01/02 2021, doi: 10.1080/1034912X.2019.1650902.

[12] M. E. Bargerhuff, H. Cowan, and S. A. Kirch, "Working toward equitable opportunities for science students with disabilities: Using professional development and technology," *Disability and Rehabilitation: Assistive Technology,* vol. 5, no. 2, pp. 125-135, 2010/03/01 2010, doi: 10.3109/17483100903387531.

[13] F. B. V. Benitti, "Exploring the educational potential of robotics in schools: A systematic review," *Computers & Education,* vol. 58, no. 3, pp. 978-988, 2012/04/01/ 2012, doi: https://doi.org/10.1016/j.compedu.2011.10.006.

[14] M. C. Di Lieto *et al.*, "Improving Executive Functions at School in Children With Special Needs by Educational Robotics," (in eng), *Front Psychol,* vol. 10, p. 2813, 2019, doi: 10.3389/fpsyg.2019.02813.

[15] S. Lindsay and K. G. Hounsell, "Adapting a robotics program to enhance participation and interest in STEM among children with disabilities: a pilot study," (in eng), *Disabil Rehabil Assist Technol,* vol. 12, no. 7, pp. 694-704, Oct 2017, doi: 10.1080/17483107.2016.1229047.

[16] M. Á. Conde, F. J. Rodríguez-Sedano, C. Fernández-Llamas, J. Gonçalves, J. Lima, and F. J. García-Peñalvo, "Fostering STEAM through Challenge Based Learning, Robotics and Physical Devices: A systematic mapping literature review," *Computer Application in Engineering Education,* vol. 29, no. 1, pp. 46-65, 2021, doi: 10.1002/cae.22354.

[17] I. Anglmayer, "Implementation of the Employment Equality Directive in light of the UN CRPD," European Parliamentary Research Service, 2020.

[18] Eurostat. "Early leavers from education and training (age group 18-24) by type of disability, sex and labour statu." https://ec.europa.eu/eurostat/databrowser/view/hlth_de010/default/bar?lang=en (accessed 07/11/2023.

[19] UNESCO, S. a. C. O. United Nations Educational, Ed. *Inclusion and Education: All means all*. France, 2020.

[20] M. D. Josipa Friščić, Milan Šveřepa, "Anual Report 2020 - Inclusion Europe - European movement of people with intellectual disabilities and their families.," 2020.

[21] M. Hersh, "Technology for inclusion," 2020. [Online]. Available: https://unesdoc.unesco.org/ark:/48223/pf0000373655

[22] European-Union, "Erasmus+ Programme Guide." [Online]. Available: https://erasmus-plus.ec.europa.eu/sites/default/files/2023-04/ErasmusplusProgramme-Guide2023-v3_en.pdf