

Article

Engaging Environmental Sciences Students in Statistics through an Inclusive Experience in a Spanish University

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Abstract: In Spain, the issue of people with disability's access to adapted educational material is still unresolved in the university context. Other insufficiently addressed issues comprise actions to include students with intellectual disability in university classrooms, and the awareness-raising and sensitisation of undergraduate students regarding disability. These deficiencies persist despite the known benefits of these types of initiatives for all the agents involved. For this reason, we carried out an inclusive experience at the Pablo de Olavide University, specifically in the statistics subject. Educational resources were adapted, inclusion activities were conducted with students with intellectual disability, and we were in charge of awareness-raising and sensitisation of undergraduate students. The present paper describes the experience as well as its evaluation, which was performed using a survey. Furthermore, the work compares the achievement of students with a more engaging system that incorporates inclusive teaching versus one that does not. The results, which were statistically analysed, report high levels of satisfaction for all the involved agents, as well as improvements in the academic performance of the students. Recommendations directed towards both teaching staff and educational authorities are also provided on how to promote inclusion in universities and more specifically inclusion in science. These suggested educational policies aim to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all, based on the Sustainable Development Goal 4 of the 2030 Agenda for Sustainable Development.

Keywords: accessibility; awareness; disability; higher education; inclusive science; statistics; teaching support

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1. Introduction

According to the World Health Organization, about 15% of the world's population (i.e., more than one billion people) has some form of disability. People with disability thus constitute the largest minority in the world and numbers are increasing with advances in medicine and the growth and aging of the population. That is why the fourth goal of the 2030 Agenda for Sustainable Development aims to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all [1]. On the other hand, the latest 2017–2018 academic year CRUE report states that 14,930 students with some type of disability are studying for bachelor's degrees in Spanish public universities, of which 12% (1798) are studying in Andalusian universities [2]. Society cannot look the other way in the face of such an obvious reality. Universities play a fundamental role in the training and incorporation of students with disability, a crucial pillar in the improvement of the welfare state.

On 13 December 2006, the International Convention on the Rights of Persons with Disability was approved in New York. It provides measures, of both non-discrimination and positive action, that states must implement to ensure that disabled people enjoy their rights on equal terms with other people. Spain was one of the first countries to ratify this

international treaty [3], whose article 24, subsection 5 holds: “Member States shall ensure that persons with disability have general access to higher education, vocational training, adult education and lifelong learning without discrimination and under equal conditions than the others. To this end, Member States shall ensure that reasonable accommodations are made for persons with disability”. That is why Spanish public universities must comply with these precepts. In this sense, it is important to highlight that current Spanish regulations reserve 5% of places in each university degree for people with disability (see article 26 of Royal Decree 412/2014, of 6 June 2014 [4]). The incorporation of a quota for people with disability into the laws that regulate access to university represented a great advance in the fight for the educational and social integration of this group. It was a clear example of positive action policies towards people with disability. Recently, Royal Decree 822/2021, of 28 September 2021 [5] extended the reserve quota in force for undergraduate studies to official university master’s degrees. In addition, it reserves the places available for students with disability who attend the extraordinary calls for access to university, until 5% of the reserve quota of the total number of places offered in the degree in question is reached. However, there is still a long way to go, as demonstrated by García-González et al. [6], who identified barriers to higher education for students with disabilities in Spain.

Through higher education, Spanish public universities play a crucial role in training professionals, leading to a more accessible, egalitarian and fair society. They also empower people with disability and promote their talents. The Pablo de Olavide University (UPO) is strongly committed to supporting people with disability and is working towards an increasingly accessible and inclusive university, where universal accessibility is a reality in the classroom—not merely a future goal. In fact, articles 6.4 and 133.1 of the UPO Statutes include these fundamental principles as basic rules of organisation and operation (see Decree 298/2003, of 21 October 2003 [7]). Moreover, in 2019, the UPO Vice-Chancellor’s Office for Culture and Social Commitment promoted the Second UPO Accessibility and Inclusion Plan for Functional Diversity [8] to regulate actions aimed at UPO people with functional diversity and to guarantee equal opportunities during their stay at the institution. This plan is inspired by the “Independent Living Movement” which promotes the values of integral formation, autonomy, empowerment and responsibility.

The presence of students with disability and specific educational support needs in university classrooms is a reality today. Since 2020, these students have benefited from a good practice guide [9], directed towards facilitating their access to university and preventing first-year university drop-out. University teaching staff must guarantee accessible and inclusive training, so that the necessary tools to guarantee competence acquisition are available to all students, regardless of their learning difficulties. Unfortunately, this scenario does not always play out, and daily students with some type of disability face varying degrees of academic barriers. The Fifth Study on the Degree of Inclusion of the Spanish University System regarding the Realities of People with Disability [10] examined the ways to improve the inclusion of people with disability at university. It concluded that efforts should be mostly oriented towards the adaptation of resources that allow quality distance education. The reason is that 22% of university students with disability considered that the main way to improve their inclusion at the university was to adapt the resources to study from home. This was followed by 14% of students with disability who referred to the elimination of architectural barriers that still existed for people with mobility difficulties. This lack of resources has an additionally negative impact in the case of the statistics subject, due to the idiosyncrasy of the discipline and the scarce amounts of teaching support materials adapted to functional diversity. Aware of these difficulties, the authors of this work undertook the challenge to create specific audiovisual content on descriptive statistics, adapted to people with hearing and visual impairment.

It has been found, moreover, that providing an inclusive education to students with intellectual disability in higher education is an emerging challenge [11]. This latter study confirmed that, from the students’ perspective, university environments could be suitable

for students with intellectual disability. The creation of inclusive higher education programmes should therefore be encouraged [11]. In this sense, the Training Programme for Employment and Autonomous Life of People with Intellectual Disability (FEVIDA) was established at the UPO in 2017. It is a social innovation university programme designed to train 17 young people between the ages of 18 and 29 to improve their possibilities of employment and autonomous life. During the 2021–2022 academic year, these students with disability are and will be receiving 30 credits worth of training in practical, humanistic and professional subjects on the university campus. Extracurricular activities, activities shared with undergraduate and postgraduate students of official studies, as well as other actions that take place within the university community, complete the Own Title. This fifth edition includes an innovative experience aimed at promoting the autonomous life of these students with functional cognitive diversity. They will spend a week of community immersion, staying at the Flora Tristán university residence. Further information on FEVIDA can be found both in [12] in its classic version, and in [13], in its version adapted for easy reading. The authors of this work, convinced of its potential, incorporated the statistics subject of both the Degree in Environmental Sciences and the Dual Degree in Environmental Sciences and History-Geography at UPO in the FEVIDA's fifth edition.

Despite the need of the current society of inclusive higher education experiences that inspire and motivate other university teachers, there is still not enough work addressing this challenge. However, the study of the inclusion of people with disability at university has been developed with more intensity in recent years in different parts of the world, as can be found in [11,14–24]. Unfortunately, this trend is not as exciting if we focus on the field of science in general and statistics in particular. Nevertheless, in Spain emerging groups of researchers work to make the science accessible to all kind of people regardless of their age, social status, functional diversity and academic level [25–27]. In this sense, both the adapted teaching material and the inclusive workshop prepared by the authors are proposals where the processes of knowledge transfer of statistics are aimed at people with disability. The main goal of these inclusive actions is to make statistics accessible to all audiences without regard to their abilities; at the same time students with disability are encouraged to undertake scientific careers and science teachers to make their work more inclusive.

The present paper describes how this inclusive experience unfolded, detailing the adapted teaching support material elaborated, as well as the inclusive activities shared by undergraduate and FEVIDA students. All these activities took place in an environment of awareness, sensitisation and respect regarding disability and functional diversity within the context of a science subject. A total of 43% of the undergraduate students enrolled in the subject participated in a questionnaire to evaluate the integration experience. The questionnaire data and student academic results were statistically analysed. The intended outcome was the promotion, protection and guarantee of the full and equal enjoyment of all human rights and fundamental freedoms of all persons with disability, as well as the promotion of respect for their inherent dignity (article 1 of the Convention on the Rights of Persons with Disabilities [28]).

2. Materials and Methods

During the first semester of the 2021–2022 academic year, we conducted a series of actions in the statistical subject of the Degree in Environmental Sciences and Dual Degree in Environmental Sciences and History-Geography at the UPO. These actions were designed to make this subject more accessible to students with disability, to incorporate students with some type of intellectual disability, as well as to sensitise the whole class about an increasingly diverse and enriching social environment. Therefore, they sought to achieve the four primary objectives detailed below.

1. Improve the acquisition of competences in the statistics subject of all students, including those with some type of disability, with a special emphasis on hearing and visual impairment. To reach this objective, new audiovisual material specially developed for statistics was created, which was in turn adapted to people with hearing and visual disability, that facilitated studying the subject and acquiring competencies. In other words, not only the learning process of statistics students was eased, but also everyone was included, since some of the students' special needs were addressed.
2. Promote the inclusion of people with disability at the UPO, especially students with intellectual disability, raising awareness of the need to integrate people with some type of disability into the classroom. A theoretical-practical descriptive statistics session was held, adapted to their special needs in an inclusive way, where the rest of the classmates participated very actively. This allows the UPO graduates to promote respect for diversity, equity and equality when they integrate into the labour market in the future.
3. Make university students aware of diversity, including people with disability, generating experiences that bring this reality closer to students, raising awareness about the importance of educational inclusion, promoting an education based on respect, solidarity and tolerance.
4. Analyse whether the students' average grade improves when the subject is inclusive. If the mark in the different tests increases when the subject is inclusive, the belief that all the actors benefit from an inclusive subject will be strengthened.

To reach these objectives, the authors applied statistical techniques as Pearson's chi-square test for the independence of two qualitative variables, or Fisher's exact test when convenient; likewise, to study the difference between the means, the normality test, the non-parametric technique of Mann-Whitney's and median difference test were studied.

The previous objectives were based on the assumption that both teachers and students prepared materials and activities in a clear and simple language, using short sentences, including images or pictograms, avoiding negative sentences and metaphors and providing easy reading. According to the UNE 153101:2018 EX standard, easy reading is a tool that allows us to make texts and documents understandable for everyone. The easy reading method collects a set of guidelines and recommendations related to the writing of a text, the design/layout of documents, and the validation of their comprehensibility, in order to make information accessible to people with reading comprehension difficulties. The easy-to-read materials prepared by the teachers were not only designed for people with disability, but also for people with low educational levels, social problems, language difficulties and immigrants.

Specific activities were developed for the three first objectives and are detailed in the following subsections; meanwhile the fourth objective is addressed in Section 3.

2.1. Creation of Teaching Support Materials Adapted to Functional Diversity

This subsection explains how the authors of this work developed training pills on basic concepts of the subject that were accessible to students with hearing and visual impairment. The purpose of these resources was to work on the competencies required in the descriptive statistics block of the statistics subject taught in the Degree in Environmental Sciences and Dual Degree in Environmental Sciences and History-Geography at the UPO. The teaching or training pills were each of the small parts into which the content was divided in the "microlearning" methodology, which has great advantages in both formal and non-formal education. These teaching pills are much easier to assimilate and are taught through different means, among which the use of new technologies stands out.

The audiovisual material was made accessible to people with hearing disability through subtitling and translation into sign language. Subtitling consists of simultaneously displaying written text and images on the screen. The problem with sign language

translation is that each country or region has a different language. This makes it extremely difficult to generate universally accessible audiovisual material. While subtitling is valid for all Spanish-speaking countries, the translation into sign language needs to be adapted to each country or region. The audiovisual material developed by the teachers combined subtitling with sign language translation by an official interpreter. In this way, a person with both hearing disability and low reading abilities could enjoy the statistics subject contents on equal terms with the rest of the students. Teachers had to collaborate with the sign language interpreter to develop their work adequately, for example, by advancing the common technical vocabulary used in order to anticipate the translation into sign language.

In addition, the material developed contained contextualised examples in environments the students are familiar with, which facilitates learning. Likewise, the material addressed descriptive statistics contents very useful in real life, so it also helped people with some mathematical knowledge and a desire to learn.

Specifically, the teachers elaborated the three following teaching pills adapted to the needs of people with hearing disability:

- The arithmetic mean [29], which is the most widely used descriptive statistic in real life. The arithmetic mean or average, or simply the mean or average if the context is clear, is the sum of a set of results divided by the total number of results. By delving into its advantages, disadvantages and different forms of calculation, we better understand its potential. Specifically, the average is theoretically defined, simple examples are given, the pros and cons of its use are analysed and some of its properties are shown. A simple illustration of the weighted arithmetic mean was also defined and presented. Finally, two exercises were given to practice the average for discrete and continuous statistical variables, as well as another exercise to work on the weighted arithmetic mean.
- The median [30], which is a broadly recognised descriptive centralisation statistic, not influenced by atypical values. The median is the midpoint at which no more than half the values are above or below, that is, the median is the value separating the higher half from the lower half of a data sample. The material began with the definition of the median, followed by an explanation of its calculus when the data are not grouped in frequency tables (distinguishing the cases when the total is an odd or even number). An explanation was also given on how the median is calculated for data grouped into frequency tables, differentiating between discrete and continuous statistical variables. The advantages and disadvantages of this descriptive central tendency statistic together with several examples were shown as well.
- The mode [31], which is a widely used descriptive centralisation statistic. The mode is the most frequent value found in a set of data values. This learning capsule begins with the definition of the mode and continues with the explanation of its calculus, distinguishing whether the statistical variable is qualitative, discrete quantitative, or continuous quantitative. Various examples of the three types of variables were presented, including one where the distribution was bimodal. The strengths, weaknesses and properties of this central tendency descriptive statistic were also analysed.

The three training pills contained a support annex that included the complete transcription of the videos and materials, as well as the exact minute of the recording, in order to support all the students in their learning. Furthermore, these annexes are being translated for the ONCE Scientific Editor (EDICO), so that they will be accessible to blind or severely visually impaired students. EDICO is the first Accessible Mathematics Editor that allows blind or severely visually impaired students to follow maths, statistics, physics or chemistry classes, thanks to the transcription into Braille code. That is why these teaching support materials are also adapted to students with visual disability.

It is important to note that students who are blind or have low vision use a software, such as JAWS (Job Access With Speech), which reads everything on the computer screen aloud. However, these screen reader software packages have the limitation of not reading

formulas, scientific signs or mathematical signography, an aspect to be covered by ED-ICO. Consequently, there is a gap in the teaching support material adapted to students with visual impairment in the field of STEM (science, technology, engineering and mathematics) subjects, a gap that increases as one ascends through the different educational levels.

These new teaching support materials were designed to allow students with disability to undertake the studies in which they were enrolled under the same conditions as the rest of the students. They aimed at promoting full inclusion, in accordance with equal opportunity and non-discrimination principles. The goal was thus that all students reach their maximum personal, intellectual, social and emotional development, and that the objectives established in the current law were attained.

Finally, these audiovisual documents have been included in UpoTV, which is UPO's multimedia repository. In this way, these statistics training pills are open to all people who require them, regardless of whether they have disability or whether they are part of the UPO university community or not. This aspect is an important milestone: indeed, such specific, as well as transversal statistical material is almost impossible to find on the internet (whether free of charge or not). To guarantee the technical quality of these training pills, the teachers sought the advice of the UPO Library Multimedia Laboratory.

2.2. Inclusion of Students with Intellectual Disability in University Classrooms

This subsection describes the two-hour workshop on the statistics subject of the Degree in Environmental Sciences and Dual Degree in Environmental Sciences and History-Geography. It took place during the first semester of the 2021–2022 academic year and was adapted to the special needs of people with intellectual disability in the FEVIDA programme. All those enrolled in the subject in both degrees, i.e., a total of 121 students, participated in the FEVIDA workshop as assistants.

At the beginning of the semester, teachers presented the project to the undergraduate and FEVIDA students, providing a Google form in which they registered in the workshop in order to actively participate. Finally, 45 undergraduate students and 11 FEVIDA students signed up to the workshop, out of the 121 students enrolled in the subject and 17 enrolled in FEVIDA. The activity was very well received by the undergraduate students: 1 out of every 4 students in the subject became actively involved; and of these, 73% answered the assessment survey. This allowed us to gather their specific opinions about the activity, and make future improvements, by enhancing the detected strengths and correcting the weaknesses.

Throughout the semester, several face-to-face and virtual sessions took place between the teachers and the undergraduate students via the Blackboard Collaborate Ultra platform. These meetings addressed not only the topics to focus on, but also the way in which to work on them: enhancing FEVIDA students' autonomy, encouraging their active participation, avoiding infantilisation, etc. Following a number of meetings that were held outside class hours, the teachers and the undergraduate students agreed on a series of topics for the inclusive statistics workshop, detailed below.

- Topic 1: arithmetic mean. At the beginning of the workshop, the undergraduate students presented some theoretical notions. FEVIDA students learnt to work out the average, for example, the average mark of several exams. Undergraduate students prepared a variety of highly practical exercises that required the active participation of FEVIDA students. Two concrete examples of mean drawbacks were also presented: one to explain that if the variable is discrete, the average might not belong to the variable's set of values, and another to show that the arithmetic mean is sensitive to extreme values.
- Topic 2: household economy. Undergraduate students prepared some activities where FEVIDA students worked on monthly/annual expense concepts, instilling the monthly savings necessary to meet annual expenses such as car insurance. Various

cases of real spending were introduced where FEVIDA students had to manage several house expenses based on a salary or pension.

- Topic 3: discounts. FEVIDA students learned how to calculate the cost of discounted items. Specifically, undergraduate students explained how to compute the price of an item with a 25% or 30% discount, what it meant when a second item was 50% or 70% off, how to calculate the cost of products in the case of promotions such as 2×1 or 3×2 , etc.
- Topic 4: games of chance. Undergraduate students introduced the concept of probability calculus based on the Laplace rule. The probabilities were calculated for games of chance with dice, cards and the Christmas lottery. This latter example was chosen because the lottery is highly traditional and popular in Spain.
- Topic 5: statistics in social networks. FEVIDA students learnt to interpret the data provided by social networks on “likes”, statistics of photos associated with questions, etc. The practical activity consisted of taking a photo of everyone at the beginning of the class, uploading it to social networks, and analysing the percentage of responses to the questions posed at the end of the class. To carry out this activity, all participants gave their consent for the publication or dissemination of the image.
- Topic 6: Kahoot. Kahoot is known to be a highly motivating method for evaluating and reviewing content. The quiz contained questions related to the contents explained and worked on during the class. FEVIDA students could use the mobile calculator for the resolution. By default, Kahoot allocates 20 s to each question, but undergraduate students adjusted it to 240 s to avoid stressing the FEVIDA students.

The inclusive statistics workshop was eminently practical, dynamic and participatory for both undergraduate and FEVIDA students. In fact, the undergraduate students explained some basic statistics concepts to their FEVIDA classmates adopting a pragmatic perspective. The teachers had a supervising role during the workshop. The result of this experience was twofold: making students with intellectual disability more familiar with statistics, and bringing undergraduate students closer to the realities of people with disability.

2.3. Disability Awareness

Disability awareness, which is part of an inclusive culture, promotes positive attitudes of appreciation, respect, solidarity and tolerance towards disability. Carrying out disability awareness activities encourages coexistence, develops empathy and favours the acceptance of people with disability.

In addition to the preparation of the FEVIDA workshop described in the previous section, examples, exercises and problems in the field of disability were frequently used during the statistics classes. Official statistics on people with disability were also analysed. In this transversal way, the teachers tried, through positive and inclusive language, to make their students gain awareness of the daily difficulties faced by people with disability and their strength at overcoming them. Through these activities, the teachers also encouraged their students to appreciate the abilities and achievements of people with disability. Naturally, in all the developed activities, exercises and examples about statistics were also combined within the context of environmental problems, as well as the conservation and protection of the environment and nature, as is typical of the degree in which the subject is taught.

These activities are essential. Indeed, according to the Universia Foundation [10], less than 31% of students recognise having received sensitisation sessions on people with disability. In addition to promoting awareness about disability across classes, universities should promote training courses on disability aimed at undergraduate students, and they should be recognised as free credits.

3. Results

The evaluation process was similar to any proper academic and educational activity. On the one hand, the undergraduate students were evaluated as specified in the subject's General and Specific Teaching Guides. In addition, undergraduate students prepared assessment exercises for FEVIDA students to perform independently at home. They were delivered to teachers' lockers within a set deadline. The responsibility of delivering homework on time to the teachers' lockers implied that FEVIDA students acquired typical undergraduate student routines, which helped them to feel autonomous and empowered. Moreover, the teaching staff was subject to the student satisfaction surveys about the teaching activity, that is, a teaching staff evaluation process that is institutionally conducted by the UPO.

At the end of the first semester of the 2021–2022 academic year, students enrolled in the statistics subject of the Degree in Environmental Sciences and Dual Degree in Environmental Sciences and History-Geography at the UPO were invited to take a survey through Google Forms, available in the virtual classroom. The survey was anonymous and participants were assured that their responses would not be identifiable. The questionnaire data were analysed using the statistical package IBM SPSS Statistics 27.0 (IBM, New York, NY, USA). The survey questions that undergraduate students asked about the activity can be found in the Appendix A.

Of note, undergraduate students evaluated this experience through Google Forms. Specifically, 52 undergraduate students filled out the survey: 42% men and 58% women. All students who actively participated in the workshop showed the highest levels of satisfaction with the activity.

Although it was female students who were primarily involved in preparing the FEVIDA workshop activities (almost 2 out of 3 participants in the preparation of exercises were female), no statistical relationship was found between gender and active participation in the workshop activities (Fisher p -value = 0.569). Indeed, the workshop was well received by male and female students alike. In fact, the workshop participants' degree of satisfaction was notable, both that of the attendees and that of the students who organised the activities: 100% indicated being satisfied with the workshop experience and 9 out of 10 students said they were very satisfied or completely satisfied.

However, the first, unfortunate surprising fact was that 63% of undergraduate students said that their level of knowledge of the different types of disability was insufficient. Only 2% claimed that they had very good knowledge of the different types of disability. That is why different educational institutions at all levels should promote integration activities for students with functional diversity, since the benefits generated for all parties are remarkable. It would also be interesting for educational institutions to promote training on the different types of disability, in order to promote general social awareness of the limitations and challenges faced by these individuals on a daily basis.

On the other hand, the survey showed that more than 70% of the students did not doubt the sensitivity of people with disability and only 25% believed that they became difficult to deal with over time. Only a minority thought that older people, due to their age, were people with disability. Indeed, only 13% expressed this opinion, and a large majority of the students surveyed, 62%, were aware that in the future they could develop a disability.

The study also indicated that 81% of those surveyed considered that people with disability were not sufficiently protected in Spain. The perception that not enough was being done was palpable after analysing the results. Almost 9 out of 10 students affirmed that insufficient actions were being taken by the authorities to further integrate people with disability, and 87% said that more money should be spent to remove physical barriers in order to make life easier for people with physical disability.

The inequality suffered by people with disability was confirmed once again: 3 out of 4 students surveyed perceived the lack of real-life opportunities for people with disability who shared the same skills, aptitudes or diplomas as persons without disability.

At this point, we asked whether activities such as the FEVIDA workshop served to raise awareness about the different daily life realities in a society. The answer was resoundingly positive, given that 100% of the students confirmed that dealing with people with disability had helped them to understand another social reality, to gain awareness of the situation of others, and to be conscious that some people in society needed help. Small day-to-day problems were diminished after dealing with people with disability, since after having followed the FEVIDA workshop, 4 out of 5 students believed the problems of their daily life seemed less important. Almost all students became aware that dealing with people with disability had made them to improve as people, and that a functional diversity team enhances everyone's learning.

Having exhaustively analysed the impact of an active participation in the workshop on undergraduate students, we immediately realised that the training activity was a success. Not only had it served to improve the competence worked on in the group work subject, but also all the students affirmed that it taught them to manage time correctly, to help each other, and to progress in the group's objectives through the appropriate execution of the role of each.

The workshop undoubtedly made undergraduate students reflect on disability, although this was not the first time they had done so. A total of 83% stated that they had already reflected on the matter on other occasions.

Finally, undergraduate students were asked about the teachers' underlying motives in setting up such a workshop, involving students with intellectual disability in the statistics subject. The answers obtained are illustrated in Figure 1.

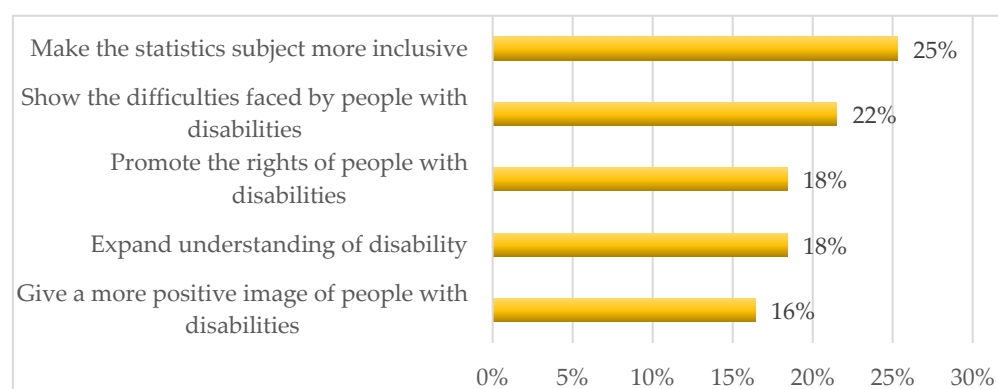


Figure 1. Perception of the purposes of the FEVIDA workshop.

The purpose most referred to by the students attending the workshop was “making the subject more inclusive”, followed by “showing the difficulties that people with disability face every day”. The undergraduate students also frequently selected the motives of promoting the rights of people with disability in state universities and broadening the understanding of other realities. Finally, it should be noted that among all the purposes, the least mentioned was “giving a positive image of people with disability”, which confirms the students' degree of understanding of the purpose of the FEVIDA workshop.

The workshop coordinators highlighted the following elements: the resounding success of the activity; the excellent reflection exercise that took place in the classroom with all the actors involved; and the need to work towards a more inclusive university, where functional diversity is a reality, leading to enriching synergies between students and teachers in the classroom.

In addition, upon data analysis, it is very important to highlight that disability is not a gender issue. No statistical evidence was found relating gender to any of the opinions and perceptions expressed by undergraduate students. In the study's pertinent questions, the answers of male and female students were greatly similar in all cases.

In order to cover the proposed fourth objective of detecting a change or improvement in the average grade when the subject has been inclusive, the average grades of the three exams carried out throughout the semester were analysed to evaluate the students of the Degree in Environmental Sciences. To this goal, the data of two academic years were taken, the 2020–2021 course where there were no students with disability in the classroom, and the 2021–2022 course where the subject was inclusive and the FEVIDA workshop was held. The data showed a significant increase in two of the three exams carried out in the course with the inclusive subject, as shown in Table 1. Both the data distribution and the median of the analysed distributions were statistically different in two of the three evaluation exams. Specifically, the average mark of the first exam increased by almost 13%, from 5.59 to 6.30 points. On the other hand, the mark of the knowledge exam using the SPSS statistical programme further increased the average score in the inclusive course, almost 40%, from 3.64 to 5.05 points.

Table 1. Scores of the statistics exams of the Degree in Environmental Sciences.

	Course 2020–2021		Inclusive Course 2021–2022		<i>p</i> -Value
	Mean	Standard Deviation	Mean	Standard Deviation	
First exam score	5.59	1.82	6.30	2.26	0.006 */0.039 **
Second exam score	4.56	2.21	4.55	2.65	NS */NS **
Third exam score (SPSS)	3.64	2.10	5.05	2.63	0.002 */0.047 **
Number of students	115		110		

* Non-parametric Mann–Whitney U test. ** Test for median difference. NS = Not significant.

Last but not least, upon completion of the experience, the teachers also reflected on the need for university teachers to receive specialised training on how to make their subjects and classes more inclusive. That is why we concluded that the training unit of any public university should promote educational training and innovation processes for teachers in the field of functional diversity, since faculty members require training and information on inclusive education to meet the needs of students with disability [16]. In addition, this reflection also stemmed from the low percentage of teachers—only 14%—who had received training and guidance on the care of students with disability [10]. According to the report “Persons with Disability in the Andalusian University System” [32], Andalusian university teachers lack training on how to tutor students with disability. Nearly half the tutors (44%) stated they had not received any specific training; some tutors had received instructions or recommendations from the relevant university bodies or from the teaching team (17%), of the others, none (13%), and only 12% had taken training courses. Another motive is the fact that 57% of students with disability perceived that their teachers did not know or did not have up-to-date knowledge of their needs [10]. The competent authorities should take note of this, especially as this is not the first time such requirements have become apparent [20].

4. Discussion

The materials prepared by the teachers included content and activities adapted to the students’ diversity. Specifically, the materials were especially adapted to students with hearing and visual impairment. They also followed easy reading standards and were thus accessible to people with low educational levels, with social problems, language difficulties and immigrants. In addition, it was easier for students to control and manage their learning itinerary based on their ability or previous knowledge. Likewise, the material produced was all the more relevant since there is little or no public offer of contents that attend to diversity. Therefore, the didactic materials elaborated are very useful, because they responded to a weakness detected in the teaching–learning of the statistics subject addressed to people with disability. Furthermore, this lack of adapted teaching support

materials—that affects all fields of knowledge—is more significant in the field of statistics. Indeed, the absence of adapted material must be added to the necessary prior knowledge of mathematics, as well as the level of abstraction required to understand the subject. There is still, however, a long way to go to achieve true equal opportunities for people with disability in education.

In addition, the inclusion of FEVIDA students in a statistics class of undergraduate students marked a before and after in the teachers' personal and professional lives. The experience made it possible to promote the inclusion of people with intellectual disability at the UPO, raising awareness of the need to integrate people with some type of disability in the classroom. Undergraduate students gained awareness of a diverse society in which all people, regardless of their condition, should have the same opportunities to face life, with all its obstacles and goals. At the same time, FEVIDA students understood that they were an active component of the citizenry, and their talents contributed to a more homogeneous development and progress of the community. In this sense, the research confirms that inclusive education presents high levels of teacher and undergraduate student satisfaction, in addition to improving the academic performance of students. The academic managers of the FEVIDA programme also reported high scores for students with intellectual disability's satisfaction. This fact corroborates the results obtained in [11]; that is, university environments can be suitable for the education of students with intellectual disability and, therefore, the creation of inclusive higher education programmes should be encouraged. That is why the authors suggest generalizing and replicating the successful experiences at the UPO regarding the inclusion of students with disability in the educational system, as recommended in [24].

On the other hand, authorities should develop laws and strategies encouraging university faculties to elaborate inclusive materials in their subjects and to incorporate students with disability in their classes. In the development of these educational policies, the competent authorities cannot lose sight of the fact that the existence of adapted teaching support material decreases as we advance through the different educational levels, being more pressing in the case of STEM subjects. This involves an added difficulty for students with disability studying at university in the scope of STEM. In fact, students with disability tend to study degrees related to engineering and architecture and sciences to a lesser extent than the general population; in contrast, they study in a much higher percentage of arts and humanities degrees, with lower labour insertion rates than other branches [33]. The authors have shown that it is possible to approach and explain the statistics subject to students with disability in a valuable way for this group, banishing prejudices shared by teachers, students and society in general about the distrust in the democratisation of science [27]. Therefore, educational authorities should promote inclusive science teaching (science without barriers) and encourage teachers to develop teaching support materials accessible to all.

Faculty members should be aware of the need to guarantee quality and inclusive educational materials; in particular, statistics subject resources, for all people with disability. Obviously, these adapted teaching support materials should be openly accessible and free of charge. It is necessary to raise awareness and sensitise the university community (teaching and research staff, administration and services staff, and students) to promote the inclusion of students with disability at university. This educational recommendation working to raise the awareness was already suggested in the inclusion of deaf and hard-of-hearing students at university [24].

Finally, university teachers should undergo training in inclusive education for people with disability. These courses should meet diverse objectives and cover varying degrees of complexity and themes. Universities must have teachers with inclusive profiles who are interested in continuous training [17]. In fact, González-Castellano et al. [17] showed that the more accessible and inclusive the universities are, the more continuous training teachers have and therefore the more interest they have in continuing training.

Ortiz Colón et al. [19] also confirm the need for training in special needs processes to enable university teaching staff to participate in an inclusive model and reveal the teaching staff do not consider themselves sufficiently prepared to provide an educational response to students with a disability. In a similar sense, Carballo et al. [16] state inclusive faculty members recommend that other teachers become informed about disability, develop a good and close relationship with their students and value their abilities, not their limitations.

5. Conclusions

Among the most relevant conclusions that we can draw from the research work carried out is the lack of previous inclusive experiences and adapted teaching material in mathematics and statistics subjects in the university context. The deficit of integration experiences is much more significant in the case of students with intellectual disability. All this entails a gap in the protocols and procedures to support university professors in their teaching work in these subjects. In this sense, the authors propose activities that have proven successfully with students with mild intellectual disabilities. In addition, several audiovisual materials adapted to various disabilities have been proposed by the authors to understand the different theoretical concepts of statistics.

This contrasts with the fact that the proliferation of free educational videos of any statistical content has grown exponentially over the past decade. Students today have at their disposal a large amount of audiovisual material to review the contents explained in class. However, it is almost impossible to find material adapted to the needs of people with disability. This evidence, together with the fact that the statistics subject is taught in the first year of many university degrees, led us to focus on this line of research and to pursue the publication of statistics contents adapted to students with different types of disability. In this way, the statistics subject has been made more accessible to everyone, and we progressed towards a more egalitarian university, one that is aware of the enrichment that comes with student diversity.

The initiative exposed above aims to raise awareness in the educational community generally, and the university community in particular. It sought to respond to the lack of educational materials adapted to people with disability, especially in the area of the STEM subjects. We suggest furthermore that the National Agency for Quality Assessment and Accreditation (ANECA)—responsible for the evaluation process of various university teaching staff members—includes specific assessment criteria on the actions and measures it promotes to develop the inclusion and equal opportunities of university students with disability. That is, the educational authorities should positively value university teachers who develop adapted resources and conduct inclusion and awareness activities in their classes. Under these conditions, university teachers would be further incentivised to make their subjects more inclusive.

The experience was highly gratifying for all the people involved: the FEVIDA and undergraduate students and the teachers. In fact, teachers are hoping to repeat the experience in the coming academic year and to incorporate improvements, new topics of interest, etc. Teachers are convinced that these types of activities allow everyone to grow, in the broadest sense of the term. Students with disabilities represent a positive professional challenge for the faculty, leading to new learnings and greater professional satisfaction [22]. Therefore, we will pursue our efforts towards the achievement of a more accessible and inclusive university. University lecturers should, however, receive training on inclusive education [11]. In addition, students with disabilities emphasised the need to provide training and/or information on disability [21], a reflection we mentioned in Section 3.

The role of public Spanish universities is a key in promoting the talents of people with disability. Therefore, they must continue to develop policies to achieve real and effective equality of opportunities for people with disability in the higher education environment. This goal reflects a societal need but it also corresponds to the fourth objective to transform our world; that is, to guarantee inclusive, equitable and quality education

and promote lifelong learning opportunities for all, featuring in the 2030 Agenda for Sustainable Development and approved by the United Nations Organization in 2015 (United Nations Organization) [1].

6. Limitations and Future Research

Among the limitations that the authors have found in their research we highlight the lack of previous inclusive experiences as well as adapted material for the statistics subject in the university context. These drawbacks, together with the scarcity of teacher training in students with special needs or disability, have made authors self-taught in the field of inclusive statistics, marking a new path that is expected to serve as a model for other university teachers.

Moreover, the authors lack the academic authorities' recognition for implementing inclusive activities as well as preparing material adapted to students with disability, because this type of experience involves a large amount of invisible work by teachers.

This study also includes some limitations that entail challenges for future works. The research has been carried out in a specific subject and university context, so it would be necessary to conduct a comparative analysis of subjects of the same nature in different branches of knowledge and universities. At the same time, it would be interesting to accomplish studies differentiating according to the type of student disability. Furthermore, to develop a more inclusive higher education, the authors have decided as future research to create a workshop on statistics in the Degree in Computer Engineering in Information Systems, adapted to people with disability, where the use of information and communications technology is the main actor to promote the acquisition of basic statistical concepts. The realisation of this inclusive workshop will involve, among other aspects, the analysis of the accessibility of different computer applications for mobile devices and tablets, differentiating according to the type of disability or special need.

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Appendix A

Survey questions undergraduate students

1. Have you actively participated in the FEVIDA workshop organised in the subject of statistics of the Degree in Environmental Sciences and the Dual Degree in Environmental Sciences and History-Geography?
 - Yes, I have taken part in a working group.
 - No, I only attended the workshop.

- I have not participated in the preparation of the activities nor have I attended the workshop.
2. Please specify whether you are male/female.
 3. How satisfied are you with the FEVIDA workshop (1/2/3/4/5), where 1 is “not at all satisfied” and 5 is “very satisfied”.
 4. Evaluation of cooperative teamwork (needs improvement/good/very good):
 - Have we all learned?
 - Did we use our time efficiently?
 - Did we finish the job on time?
 - Have we helped each other?
 - Have we made progress in our group goals?
 - Have we each fulfilled our mission?
 - Did everyone correctly exercise their individual role?
 5. How much do you know about the different types of disability?
 - I know almost nothing.
 - I do not know enough.
 - I know quite a lot.
 - I know a lot.
 6. Do you think that people with disability are sufficiently protected in Spain? Yes/No.
 7. Please read the following statements carefully and tell us how much you agree or disagree (strongly disagree/quite disagree/quite agree/totally agree):
 - My life is easier than that of a person with disability.
 - People with disability are very sensitive.
 - Older people are people with disability.
 - People with disability become difficult to deal with.
 - I may also become a person with a disability.
 - More actions should be taken to further integrate people with disability into society.
 - More money should be invested in bringing down the physical barriers that make life more difficult for people with physical disability.
 8. What opportunities do you believe people with disability have to get a job, training or promotion compared to people without any type of disability and with the same skills, aptitudes or diplomas? Fewer opportunities/The same opportunities/More opportunities.
 9. Do you think that dealing with people with disability can help you to...? Yes/No.
 - To understand another social reality.
 - To be more aware of other peoples' situations.
 - To give less importance to small problems.
 - To understand that some people need help.
 - To improve as a person.
 10. Did your participation in this project make you reflect seriously for the first time on the reality of people with disability? Yes/No.
 11. Please indicate the purposes of this project (multiple answer).
 - To improve the understanding of issues related to disability.
 - To promote the rights of people with disability.
 - To give a more positive image of people with disability.

- To show the difficulties faced by people with disability in their daily lives.
- To make the statistics subject more inclusive.
- Other.

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