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Design of educational applications without programming for children with disabilities using the neutrosophic statistical method

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Abstract. As technology advances, programming has become something of vital importance and that everyone should know how to handle, based on this, many platforms have emerged to develop applications without knowing how to program, hence making life easier for those who want to develop an application but do not know how to code. As a special needs teacher, whether you work in an inclusive classroom or specialized groups, each child is different from the next; they have different needs, behavior patterns, challenges, and talents. That is why employing apps and other digital tools to personalize your approach is so beneficial; they can help you tailor your curriculum to the needs of your students without making the process time-consuming and overwhelming. In this sense, it is necessary to develop the design of educational applications without programming for children with disabilities where they can access them without complications. The design of digital educational materials will be analyzed using the neutrosophic statistical method.

Keywords: design, technology, programming, educational applications, Neutrosophy

1 Introduction

Educational systems are called to experience paradigmatic changes in their current configuration, and this process will be facilitated and accelerated by the support provided by Information and Communication Technologies (ICT) for its development. XXI century education, to develop these skills in each of its students, requires a new form of school, more flexible, personalized, and ubiquitous. Ordinary school education establishments must promote equal opportunities and ensure the permanence and culmination of students with disabilities in the educational system, providing them with respect, tolerance, and empathy through the implementation of support measures with specialized personnel and easily accessible technologies.[1]

Teachers are supposed to provide equal opportunities for students, as well as respect the rhythm and learning style of each one, in addition to meeting the educational needs of the student body by making assertive and timely curricular adaptations that allow equal participation in the established activities on the resume. The universal design of learning will allow not the modification of the curriculum. To understand the diversity of students and their characteristics, according to the disabilities they present, by making it unavoidable that teachers focus on the teaching and learning process of Boys, Girls, and Adolescents (BGA) with intellectual disabilities and use curricular adaptations.

Digital tools, if chosen carefully, can be very effective in bridging development and achievement gaps. Some general-purpose apps or apps for young learners can work wonders for students with special needs. The key is to look for the strengths that balance the challenges of each child [2]

A very important factor lies in understanding that not all students with intellectual disabilities learn in the same way, each one has their style and pace of learning. The lack of knowledge of teachers about learning styles and the importance of didactic support materials for the teaching and learning process becomes a great disadvantage for this group of subjects that participate in the educational system.[3].

Education seeks to respond to each educational need presented by each student included in the regular educational system. To achieve this, awareness has been developed in the educational community and perseverance, and seek to achieve a common goal that is to eliminate the exclusion of children and adolescents with disabilities in order to overcome the difficulties and adversities posed for the human being in the different educational fields.

The educational intervention in students with intellectual disabilities requires to be clear, clear in the sense of understanding their intellectual functioning and their adaptive behavior in order to use or apply appropriate supports so that they can build their knowledge through the use of their senses so that the Didactic material is essential in the educational process.

Children and adolescents with intellectual disabilities must have a very significant educational intervention in their classrooms to ensure their permanence and completion in the educational system. Training a teacher for

educational inclusion requires knowledge and proper management of a wide repertoire of didactic strategies that allow arriving at the most appropriate methodology to the conditions of the students, in such a way that it can meet their specificities.[4].

More and more apps are being developed to improve the cognitive abilities and other skills of children and young people with disabilities. Applications for mobile phones and tablets allow improving cognitive, intellectual, and personal skills, as well as other skills (see figure 1). For this reason, more and more proposals are being developed aimed at children and young people with disabilities.[5]

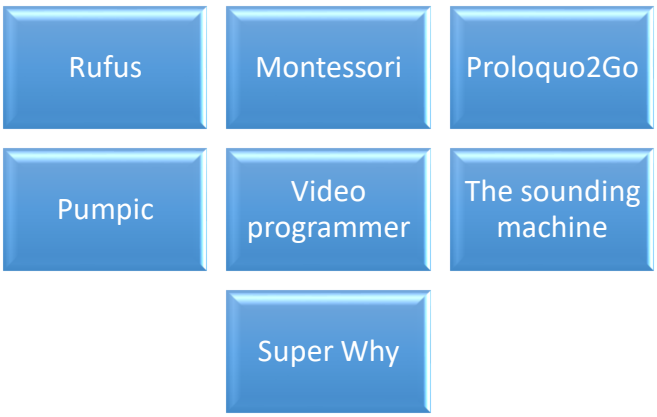

Figure 1. Applications for children with disabilities.

The planning model for students with intellectual disabilities must respond to the needs of the students for which the teacher needs to apply curricular adaptations in their planning according to the percentage and the educational need of the student. So, the teacher in the planning must make realistic approaches, that is, know the resources available in the student's context and know how far it is possible to go.

Curricular adaptations are modifications made to the elements of the curriculum, such as objectives, methodology, resources, activities, and distribution of time in class time according to the educational need of the student or students with learning difficulties, in addition, they are fundamental for access and permanence in the educational system of students with special educational needs associated with disability [6]

ICTs offer great advantages to students, teachers, and parents; they are educational platforms that present a wide variety of content and exercises to test them. Technologies have become a means of high access for educational processes, the use of digital resources is an important alternative to support the special educational needs associated with intellectual disability[7]. In recent years, these have become a powerful tool for the training and education of children and adolescents, regardless of their age. Today, they are in all walks of life[8]

Digital resources in recent decades have manifested themselves as a set of illustrations, sounds, and interactions. These elements reinforce the creativity, enthusiasm, and knowledge of the students. In the mid-2000s, the Internet connection shows the first advances in the creation of online materials and resources, interactions through the network become common experiences for citizens. Digital Educational Materials (DEM) present innovative ways of expressing and organizing information, which impacts the way these materials are used and the strategies that are implemented in the teaching-learning process.[9]

The Inclusive Digital Educational Materials (IDEM) play great support to students with Cognitive disabilities in their learning process, the students present demotivation during the teaching-learning process and lack of autonomy, which thanks to the implementation of the DEM "Portal Educational web with playful applications" facilitated their difficulties, since they influence the teaching of students by achieving optimal results in the cognitive process, linked to attention and psychomotor speed. The IDEM has had a very positive influence in the educational field, especially on students with cognitive disabilities, since they are used as a tool to facilitate the learning process of students.

The need for designs arises from helping children with a technological tool adapted to their needs, but also from helping families and educators in this task.[10]

Different research projects about the use and advantages of DEM are highlighted, which show how teachers can use them as mediating tools in the teaching-learning process when working with students with disabilities in the classroom, although it is expected that teachers continue to search for initiatives that motivate them to use them in the classroom as instruments that contribute to the integration of students in their training process. It is evident

that the projects have a geographical distribution as follows: 59.4% are from Spain, leaving Colombia and Ecuador with 19.8% [11] [12]

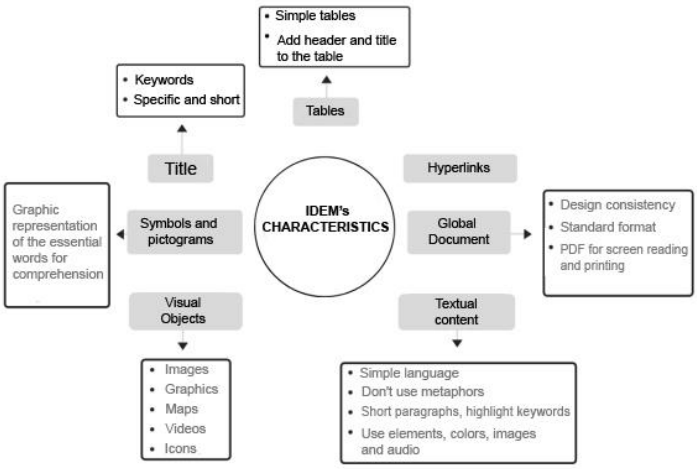

Figure 2. Characteristics of Inclusive Digital Educational Materials [13]

The lack of digital educational resources for children with intellectual disabilities is a problem for technological development that has advanced a lot, and at a great speed, since the advance in teacher training has not been so fast, due to different factors, the main reason is the lack of expert personnel to guide teachers to update themselves on technological issues and the lack of economic resources, that is, the cost of internet connectivity and technological equipment [14]

One of the projects that are well used is the orange blossom project, is a set of applications for free download for Windows and Android computers, tablets, or smartphones that help improve the quality of life and autonomy of people with autism and/or intellectual disabilities. The applications contain pictograms, images, and sounds that can be adapted to each user, adapting to the preferences and needs of each person. It includes a configuration tool, which allows tutors to customize the application so that the user can get the most out of each of the apps [15]

Another educational project designed for children with disabilities to learn to read is the one founded by Gemma and Marie Anne I also read, an application designed especially for children with Down syndrome, autism and other types of functional diversity cognitive learn to read with a methodology adapted to their needs. The application is suitable for children with different types of intellectual disability or developmental disorders. Despite this, it is a good tool for any boy or girl with neurotypical development who begins with learning to read. [16]

For the acquisition of knowledge of children and adolescents with intellectual disabilities, educational strategies must be applied through curricular adaptations to develop abilities and skills that seek to adequately and effectively satisfy the educational needs of the student.

Books-Game to work concepts

Special Words

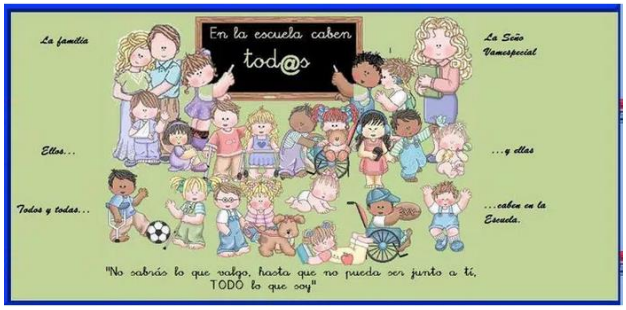

Figure 3. Materials used in special education.[15],[2]

Different types of application designs for students with disabilities have been programmed. The blog of Mrs. Vane, a Special Education teacher who proposes different materials and ideas for students and how she adapts them so that all students understand them. Another is Special words: it is a collection of 5 'puzzle' books for students with ASD (Autism Spectrum Disorder)

The teacher must be clear about the following recommendations to structure the test and thus be able to assess whether the student performs correctly with the application and whether it successfully meets the learning objectives. Objective tests do not allow the student to deviate from the objective of the evaluation:

1. You must be clear about the knowledge that the student with intellectual disability has deepened.
2. The questions must have simple language with words from their environment for easy understanding.
3. Avoid answers that have nothing to do with the question at all.
4. Multiple-choice questions should not have more than four options to avoid confusing the student.
5. The number of questions should be a maximum of 10 to obtain the attention and concentration of students with intellectual disabilities.

The design of didactic material is fundamental support for the curricular adaptations of students with intellectual disabilities because it guarantees the elimination of educational barriers and provides equal opportunities through experimentation and the development of quality learning for life. This study aims to determine the design of educational applications without programming for children with disabilities from the measurement of variables with neutrosophic criteria that enhance the purpose of facilitating the production of educational materials that favor the learning of children with disabilities, from the analysis of the method of neutrosophic statistics.

For the analysis of the design of educational applications without programming for children with disabilities, the present study defines:

- Problem situation: analysis of the design of digital educational materials for children with disabilities
- Main objective: to determine what factors educational applications for children with disabilities should present
- Specific objectives:
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  - Determine the factors that affect the analyzed variable
  - Carry out the measurement and modeling of the variable
  - Define potential alternatives based on reducing digital applications that in their designs are not beneficial for the learning of children with disabilities.

2 Materials and methods

NEUTROSOPHIC STATISTICS

Neutrosophic Statistics was founded by Prof. Dr. Florentin Smarandache, who developed it in 2014 introducing Neutrosophic Descriptive Statistics (NDS). Later, Prof. Dr. Muhammad Aslam of the university King Abdulaziz, Saudi Arabia, founded in 2018, Inferential Statistics Neutrosophic (NIS), Neutrosophic Applied Statistics Statistical Quality Control (NAS), and Neutrosophic Statistical Quality Control (NSQC).

Neutrosophic probabilities and statistics are a generalization of classical and imprecise probabilities and statistics. The Neutrosophic Probability of an event E is the probability that the event E occurs [17] the probability that event E does not occur and the probability of indeterminacy (not knowing whether event E occurs or not). In classical probability nsup≤1, while in neutrosophic probability nsup≤3+.

The function that models the neutrosophic probability of a random variable x is called the neutrosophic distribution:

$NP(x) = (T(x), I(x), F(x)),$

Where T(x) represents the probability that value x occurs, F(x) represents the probability that value x does not occur, and I(x) represents the undetermined or unknown probability of value x.

Neutrosophic Statistics is the analysis of neutrosophic events and deals with neutrosophic numbers, neutrosophic probability distribution, neutrosophic estimation, neutrosophic regression, etc. It refers to a set of data, which is formed totally or partially by data with some degree of indeterminacy and to the methods to analyze them.

While Classical Statistics deals with given data and given methods of inference, Neutrosophic Statistics deals with indeterminate data, that is, with data that has some degree of indeterminacy (unclear, vague, partially unknown, contradictory, incomplete, etc.), and with indeterminate inference methods that also contain degrees of indeterminacy (for example, instead of crisp arguments and values for probability distributions, graphs, plots, algorithms, functions, etc. can have inexact or ambiguous arguments and values)

Neutrosophic Statistics is also a generalization of Statistics of Intervals, due, among other things, to the fact that while Statistics Interval Analysis is based on Interval Analysis, Neutrosophic Statistics is based on Set Analysis (understanding by such all types of sets, not only intervals).

If all data and inference methods are determined, then Neutrosophic Statistics coincides with Classical Statistics. Since in our world we have more indeterminate than determined data, more neutrosophic than classical statistical procedures are needed.

Neutrosophic statistical methods allow neutrosophic data (data that may be ambiguous, vague, imprecise, incomplete, or even unknown) to be interpreted and organized to reveal underlying patterns.

Finally, the Neutrosophic Logic[18], the Neutrosophic Ensembles, and the Neutrosophic Probabilities and Statistics have a wide application in various research fields and constitute a novel study reference in full development.

Descriptive Statistics Neutrosophic comprises all the techniques for summarizing and describing the characteristics of neutrosophic numerical data.[19].

Neutrosophic Numbers are numbers of the form where a and b are real or complex numbers [20], while "I" is the indeterminate part of the neutrosophic number N.

$$N = a + bI.$$

The study of neutrosophic statistics refers to a neutrosophic random variable where y represents the lower and correspondingly higher level that the studied variable can reach, in an indeterminate interval. Following the neutrosophic mean of the variable by formulating:$X_l\, X_u I_N [I_l, I_u](\bar{x}_N)$

$$X_N = X_l + X_u I_N;\ I_N \in [I_l, I_u] \tag{1}$$

$$\text{Where } \bar{x}_a = \frac{1}{n_N} \sum_{i=1}^{n_N} X_{il}\ \bar{x}_b = \frac{1}{n_N} \sum_{i=1}^{n_N} X_{iu}\, n_N \in [n_l, n_u] \tag{2}$$

is a neutrosophic random sample. However, for the calculation of neutral squares (NNS), it can be calculated as follows

$$\sum_{i=1}^{n_N} (X_i - \bar{X}_{iN})^2 = \sum_{i=1}^{n_N} \begin{bmatrix} \min \begin{pmatrix} (a_i + b_i I_L)(\bar{a} + \bar{b} I_L), (a_i + b_i I_L)(\bar{a} + \bar{b} I_U) \\ (a_i + b_i I_U)(\bar{a} + \bar{b} I_L), (a_i + b_i I_U)(\bar{a} + \bar{b} I_U) \end{pmatrix} \\ \max \begin{pmatrix} (a_i + b_i I_L)(\bar{a} + \bar{b} I_L), (a_i + b_i I_L)(\bar{a} + \bar{b} I_U) \\ (a_i + b_i I_U)(\bar{a} + \bar{b} I_L), (a_i + b_i I_U)(\bar{a} + \bar{b} I_U) \end{pmatrix} \end{bmatrix}, I \epsilon [I_L, I_U] \tag{3}$$

Where $a_i = X_l b_i = X_u$. The variance of the neutrosophic sample can be calculated by

$$S_N^2 = \frac{\sum_{i=1}^{n_N} (X_i - \bar{X}_{iN})^2}{n_N};\ S_N^2 \epsilon [S_L^2, S_U^2] \tag{4}$$

The neutrosophic coefficient (NCV) measures the consistency of the variable. The lower the value of the NCV, the more consistent the performance of the factor is than that of the other factors. The NCV can be calculated as follows[twenty-one].

$$CV_N = \frac{\sqrt{S_N^2}}{\bar{X}_N} \times 100;\ CV_N \epsilon [CV_L, CV_U] \tag{5}$$

3 Results

After analyzing the different approaches in the introduction of the document, we proceed to apply the aforementioned techniques in the following way, for the design of educational applications without programming for children with disabilities. Due to the complexity and indeterminacy of the data, it was decided to apply neutrosophic statistics for the modeling of the analyzed variable.

Based on the processing of the information and the consensus of the experts, the factors that most affect it (table 1) and the variable to be modeled were determined.
Variable analyzed: development of educational applications, for a sample of n=120 for each factor (f)

Design software	Initials	Factors that affect the design of educational resources	Scale	Characteristics
Adobe InDesign	N1	You need a solid approach to establishing a network with your servers	[0 ; 5]	Allows the production of educational applications
Adobe XD	S	Modern equipment is needed to install new versions.	[0 ; 5]	It works perfectly for digital media but not for print media
Adobe Dreamweaver	N2	Not applicable as educational teaching aids	[0 ; 5]	Manage programming languages
Adobe Captivate	L	Design options are limited.	[0 ; 5]	It works perfectly for digital media but not for print media
Adobe Illustrator	N3	Not applicable as educational teaching aids	[0 ; 5]	It is a program only for design

Table 1. Incidence range for each factor.

For the modeling of neutrosophic statistics, it was decided to codify the factors to make the results viable (Table 2).

CODE	INITIALS	Factors that affect the design of educational resources
a	N1	You need a solid approach to establishing a network with your servers
b	S	Modern equipment is needed to install new versions.
c	N2	Not applicable as educational teaching aids
d	L	Design options are limited.
e	N3	Not applicable as educational teaching aids

Table 2. Determining factors for the design of educational resources

For the development of the statistical study, the neutrosophic frequencies of the determining factors in the success of the design of educational applications for children with disabilities are analyzed. For each factor, an incidence is analyzed in 5 days for each factor, which makes up the set of affectations so that the materials are a success in the learning of children with disabilities.

Days	Neutrosophic frequencies				
	N1	**S**	**N2**	**L**	**N3**
1	[2 ; 3]	[0 ; 2]	[1 ; 4]	[2 ; 4]	[2 ; 3]
2	[0 ; 1]	[1 ; 2]	[1 ; 1]	[0 ; 0]	[1 ; 3]
3	[1 ; 2]	[1 ; 4]	[1 ; 1]	[1 ; 4]	[0 ; 1]
4	[1 ; 2]	[1 ; 2]	[0 ; 0]	[3 ; 5]	[1 ; 4]
5	[1 ; 2]	[2 ; 2]	[3 ; 6]	[2 ; 4]	[1 ; 4]
6	[0 ; 1]	[2 ; 5]	[2 ; 3]	[3 ; 6]	[2 ; 5]
7	[0 ; 1]	[0 ; 1]	[3 ; 5]	[0 ; 0]	[2 ; 3]
8	[1 ; 1]	[1 ; 2]	[0 ; 0]	[3 ; 6]	[3 ; 3]
9	[0 ; 1]	[0 ; 3]	[3 ; 4]	[1 ; 2]	[0 ; 2]
10	[0 ; 1]	[1 ; 4]	[2 ; 3]	[0 ; 0]	[3 ; 5]
11	[0 ; 0]	[1 ; 3]	[2 ; 4]	[1 ; 2]	[2 ; 5]
12	[1 ; 1]	[2 ; 5]	[3 ; 5]	[3 ; 3]	[2 ; 4]

13	[0 ; 1]	[2 ; 2]	[2 ; 2]	[1 ; 1]	[1 ; 4]
14	[0 ; 0]	[1 ; 3]	[3 ; 6]	[3 ; 4]	[3 ; 3]
15	[0 ; 1]	[3 ; 3]	[3 ; 5]	[3 ; 6]	[0 ; 0]
16	[1 ; 2]	[3 ; 3]	[1 ; 4]	[3 ; 3]	[0 ; 1]
17	[1 ; 2]	[0 ; 0]	[0 ; 2]	[3 ; 3]	[2 ; 2]
18	[1 ; 1]	[0 ; 0]	[3 ; 3]	[2 ; 2]	[1 ; 2]
19	[0 ; 0]	[1 ; 1]	[3 ; 4]	[0 ; 0]	[0 ; 0]
20	[0 ; 0]	[3 ; 3]	[1 ; 2]	[1 ; 3]	[1 ; 2]
0-120	[63 ; 123]	[184 ; 377]	[194 ; 363]	[188 ; 368]	[184 ; 364]

Table 3. Neutrosophic Factor Frequencies

Table 3 analyzed the neutrosophic frequency of occurrence of the determining factors in the development of educational applications that favor the learning of children with disabilities, for 120 days, with an occurrence level of [0; 6] for each factor per day with a total uncertainty level of a=60, b=193, c=169, d=180, e=180, and a representativeness level of [46.56%; 51.19%], in the days that 6 affectations per factor are registered, with an incidence of 51% in terms of Adobe XD Software.

NEUTROSOPHIC STATISTICAL ANALYSIS

From the data of the affectations that affect the design (table 4) it will be possible to understand which factor implies a representative mean, the values of the neutrosophic means are calculated and for the study of the variations of the affectations, the values of the standard deviation neutrosophic To determine which affectation requires a greater incidence in the development of educational applications, the values are calculated.$\bar{x} = \in [\bar{x}_L; \bar{x}_U], S_N \in [S_L; S_U]. CV_N \in [CV_L\ ;\ CV_U]$

factors	$\bar{x}_N$	***YN***	***CVN***
You need a solid approach in establishing a network with your servers	[0.525 ; 1,025]	[0.16 ; 1,077]	[0.305 ; 1,051]
Modern equipment is needed to install new versions.	[1,533 ; 3,142]	[0.814 ; 2,357]	[0.531 ; 0.75]
Not applicable as educational teaching aids	[1,617 ; 3,025]	[0.777 ; 2,185]	[0.481 ; 0.722]
Design options are limited.	[1,567 ; 3,067]	[0.862 ; 2,453]	[0.55 ; 0.8]
Not applicable as educational teaching aids	[1,533 ; 3,033]	[0.742 ; 2,427]	[0.484 ; 0.8]

In table 4 it was determined that the factors, S and N2, have higher average values that affect the other factors. This means that they are, on average, the ones that most affect the teaching-learning of students with special educational needs, while the value of CV_{Nb} in N2 is lower than the rest. This means that its result has a more consistent, coherent, and precise impact when evaluating indeterminacy than the other factors in digital learning.

COMPARATIVE ANALYSIS

To calculate the associated referent uncertainty measure for para $\bar{x} = \in [\bar{x}_L; \bar{x}_U]$, $S_N \in [S_L; S_U]$ y $CV_N \in [CV_L\ ;\ CV_U]$ and to the form of neutrosophic numbers (Table 5), in the results, we observe that for the values CV_N range from 0.481 to 0.722 with the measure of indeterminacy by generating a negative impact on 33.4 it is not applied as educational teaching material and in addition to presenting programming language.

factors	$\bar{x}_N$	***YN***	***CVN***
N1	0.525 + 1.025 I;I ∈ [0,0,488]	0.16 + 1.077 I;I ∈ [0,0,851]	0.305 + 1.051 I;I ∈ [0,0,71]
S	1,533 + 3,142 I;I ∈ [0,0,52]	0.814 + 2.357 I;I ∈ [0,0,655]	0.531 + 0.75I;I ∈ [0,0,292]
N2	1,617 + 3,025 I;I ∈ [0,0,465]	0.777 + 2.185 I;I ∈ [0,0,644]	0.481 + 0.722 I;I ∈ [0,0,334]
L	1,567 + 3,067 I;I ∈ [0,0,489]	0.862 + 2.453 I;I ∈ [0,0,649]	0.55 + 0.8I;I ∈ [0,0,313]
N3	1,533 + 3,033 I;I ∈ [0,0,495]	0.742 + 2.427 I;I ∈ [0,0,694]	0.484 + 0.8I;I ∈ [0,0,395]

With the current study, it was determined that one of the main priorities of the design of educational applications for children with disabilities is to promote these applications without programming. The work methodology allows the creation of educational applications in a short period, with fewer resources, and based on the study of the particular needs of children with intellectual disabilities. Research shows that there are several ways to create educational resources for children with special needs. Thus, the emphasis should be placed on the effort to train teachers and those interested in educational issues, allowing them to contribute to the creation of resources; which will favor groups of students who have limited access to educational resources.

Teamwork between designers, teachers, and psychologists has been highlighted for the design of strategies and products that effectively solve problems in specific educational contexts and for the development of interactive digital tools for assertive teaching and learning, although these designs should be more practical when it comes to being used by this group of students since there are still applications that have a programming language which makes it difficult to access and with few or no educational tools.

4 Conclusions

At the end of the investigation, the following can be highlighted:

An Educational System is of higher quality when it is capable of serving its students with Special Educational Needs in the best possible way and although progress has been made in the design of educational applications, the lack of digital educational resources and programming for children is a problem with intellectual disability.

It is proposed to incorporate ICTs in the teaching and learning process and use programs and applications that can be used in the classroom as innovative resources for the development of skills and independence in students with disabilities and thus strengthen the learning of each one of them through respect for diversity. In addition to proposing research by graphic designers and teachers to delve into the knowledge of interactive tools of Adobe programs and applications to determine the correct parameters for the design of subsequent programs, to achieve the improvement of the academic performance of children with disabilities.

It is essential that the people in charge of working with students with cognitive disabilities focus on the use of adequate inclusive digital educational materials and, as far as possible, make the corresponding adaptations, since the use of didactic material is fundamental in the application of curricular adaptations in children and adolescents with intellectual disabilities.

The analysis of the neutrosophic statistics arrived that the Adobe Dreamweaver Software is affected because it is not applied as educational didactic material for children with disabilities, with a level of indeterminacy of 33.4% when influencing inversely proportional to the other factors, so that, if the N2 factor decreases, the other factors and progress in the education of children with disabilities increase. Neutrosophic statistical analysis shows Adobe Dreamweaver Software with a lower CV value, as an application of little use in teaching children with disabilities. From this result, it was concluded that with the design of software useful for special teaching-learning and easy access,

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