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THE FUNCTIONAL PROFILE AS A MODALITY FOR ASSESSING THE IMPACT OF AN EXPERIMENTAL INTERVENTION THROUGH UNIVERSAL DESIGN FOR LEARNING IN SPECIAL SCHOOL

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Abstract: *This article analyzes the results of the experimental implementation of an educational-therapeutic program based on the principles of Universal Design for Learning (UDL) at the Special Vocational School "Sf. Nicolae" in Bucharest during the pilot project InclusivEduHub. The study design is a multi-case analysis of data collected pre- and post-intervention, which were transposed into ICF functional profiles for 25 cases considered to be relevant for the experimental group. The statistical analysis highlights significant progress across all areas of development between the two evaluation points, while also emphasizing the importance of the functional profile as a means to capture and highlight the uniqueness of each case.*

Keywords: *Functional profile, Universal Design for Learning, intellectual disability*

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INTRODUCTION

The concept of Universal Design (UD), introduced by architect R. Mace in the 1970s, opened a new horizon for all environments, products, programs, and services intended for individuals with special needs. UD affords due respect and consideration to the diversity of human nature, viewing it as an essential premise from which all planning endeavors must originate. Universal Design for Learning (UDL) applies the principles of universal design to education. UDL specifies that an individualized approach to the educational needs of each student is required within the entire school group, but emphasizes that this differentiated and personalized approach must not isolate the student from their peer group. Therefore, in Universal Design for Learning, activity planning is conducted by considering individual characteristics as they manifest within the context of the group, as we must perceive and understand learning as a communal activity.

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In its current form, the Universal Design for Learning Guidelines 3.0 framework is organized around three major principles, they are developed through nine guidelines and a set of considerations that support their transposition into educational design.

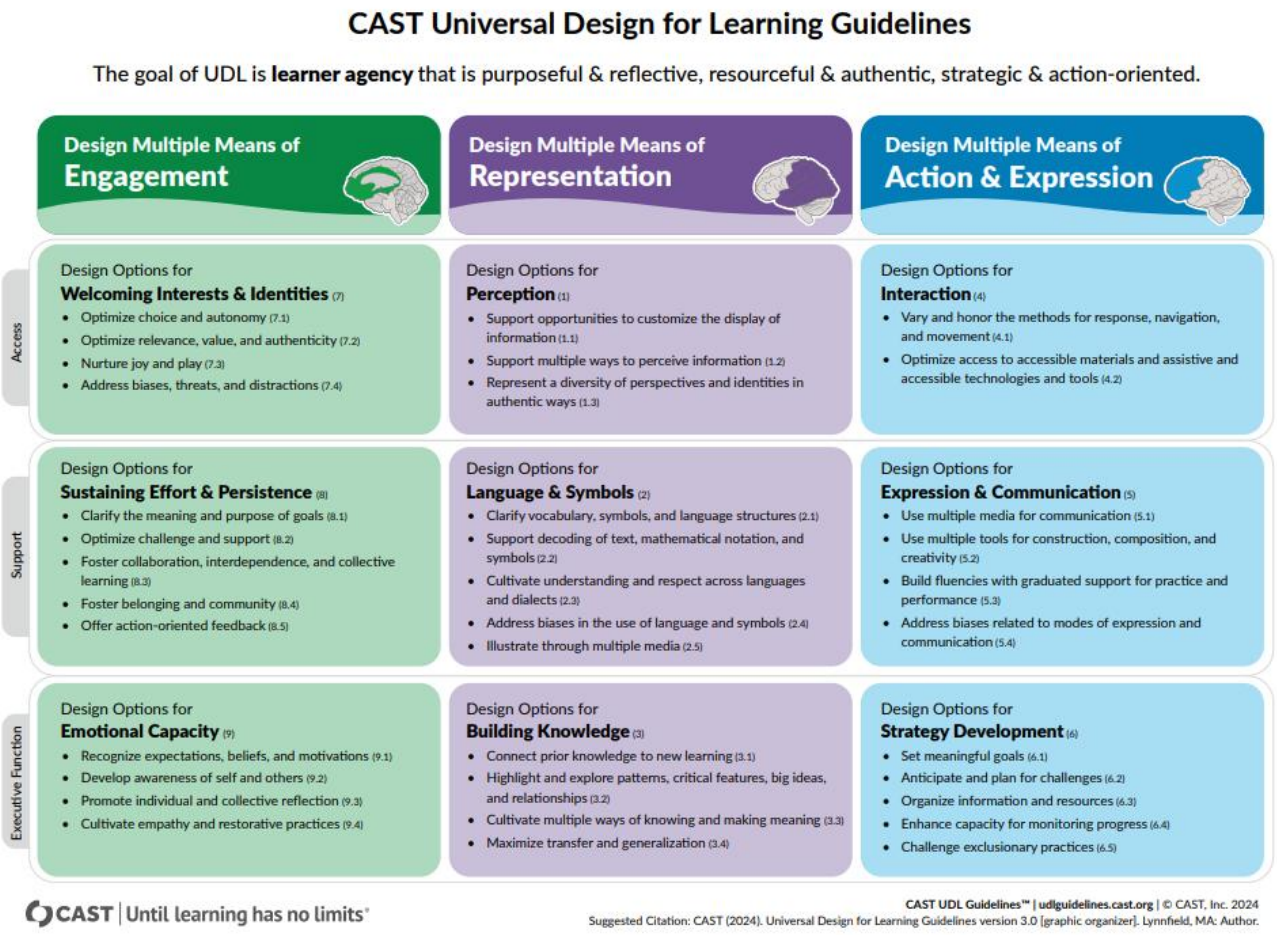

Figure1. Universal Design for Learning framework

Based on these foundations, which are the essence of contemporary pedagogy, the experimental educational-therapeutic program was developed.

Similar to Rao et al. (2017), AlRawi and AlKahtani (2022) illustrate, in a meta-analysis this time, the role of Universal Design for Learning in educating students with intellectual disabilities across academic, social, or behavioral domains. For students with intellectual disabilities the flexibly designed environment can facilitate the comprehension of task requirements, access to information, the expression of acquired knowledge, social interaction with peers, and adaptation to new school demands. At the same time, the specificities of individual functioning continue to inform the selection and intensity of psycho-pedagogical support. In this way, general accessibility and individualized intervention can be integrated into the same educational experience, creating conditions for the child's more consistent participation in classroom activities and for the progressive development of their autonomy.

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RESEARCH METHODOLOGY

The objective of this study is to analyze children's progress following the implementation of an educational program based on the principles of Universal Design for Learning (UDL), in relation to the support needs identified during the initial stage.

Research Hypothesis - It is assumed that the implementation of an educational program based on Universal Design for Learning principles contributes to improving the development of students with intellectual disabilities, implicitly by increasing their participation in learning activities.

The research was conducted in three main stages: the initial student assessment, the implementation of the educational program based on Universal Design for Learning principles, and the final assessment.

During the first stage, the initial assessment of the 25 students was carried out, aiming to outline individual functional profiles across ten analyzed areas: *Foundations of Learning*, *Language and Communication*, *Reading and Writing*, *Mathematics*, *General Tasks*, *Mobility*, *Self-Care*, *Interpersonal Interaction*, *Personal Factors*, and *Participation*.

In the next stage, the educational-therapeutic program based on Universal Design for Learning principles was implemented. Activities were organized and adapted to the students' functional characteristics and support needs by utilizing multiple means of engagement, representation, and action and expression.

At the end of the program implementation period, a final assessment of the 25 students was conducted, focusing on the same ten functional areas analyzed during the initial assessment.

Data analysis was performed, in a first stage, at an individual level, given that the primary instrument used in this research is the case study. For each of the 25 students, the initial and final assessment results in the ten areas of functioning were compared. Quantitative data were analyzed in relation to the information contained in the case studies, tracking each student's progress based on the characteristics of their functional profile and initial performance levels. Subsequently, the data were analyzed at the level of the entire sample. To describe the results, descriptive statistical indicators were used, namely: mean, median, mode, minimum and maximum values, and standard deviation. To examine the distribution of the results, skewness and kurtosis values were analyzed. The comparison of results obtained in the initial and final assessments was performed for each of the ten analyzed areas. To verify the statistical significance of the differences between the two assessment moments, a paired-samples *t*-test was used. The quantitative analysis was complemented by a multi-case analysis of the 25 case studies. Results and individual progress characteristics were compared, focusing on common aspects highlighted across multiple cases, as well as differences between students.

The research sample consisted of 25 students with intellectual disabilities, of different ages and developmental profiles, included in the educational activities carried out during the analyzed period. Participant selection allowed for tracking the application of Universal Design for Learning principles in relation to diverse individual characteristics and varying levels of support needs.

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Students included in the research exhibit a variety of developmental characteristics and associated diagnoses; the combination of intellectual disability, autism spectrum disorders, language and communication disorders, attention deficit and hyperactivity disorders, as well as other associated conditions, were encountered in various configurations. The heterogeneity of the sample is relevant to the research context, as the application of Universal Design for Learning is based on recognizing student variability and designing flexible modalities for access, participation, and expression within educational activities. Furthermore, these developmental differences necessitate the use of case studies and functional profiles. Students present different individual profiles, with varying degrees of intellectual disability, autism spectrum disorders, activity and attention difficulties, delays in language development, as well as associated neurological, genetic, and motor conditions.

Regarding age distribution, the research sample includes students aged between 4 and 18 years. The most numerous categories are represented by 8-year-old and 9-year-old students, each category comprising five students (20%). Three students are 11 years old (12%) and 13 years old (12%), respectively; two students are 5 years old (8%) and 12 years old (8%), while the ages of 4, 6, 7, 10, and 18 are represented by one student each (4%). This highlights the heterogeneous nature of the sample from the perspective of participant age.

Regarding gender distribution, the research sample consists of 17 male students (68%) and eight female students (32%). Thus, a higher proportion of male students is observed within the analyzed sample. This was not the primary criterion in forming the sample, but rather the specificity of the cases, aiming to represent the situation of students with intellectual disabilities in special education as accurately as possible.

RESEARCH RESULTS

Following the application of the aforementioned research design, pre- and post-experimental assessment data were collected through single-subject case studies and transposed into functional profiles created in accordance with the International Classification of Functioning (ICF).

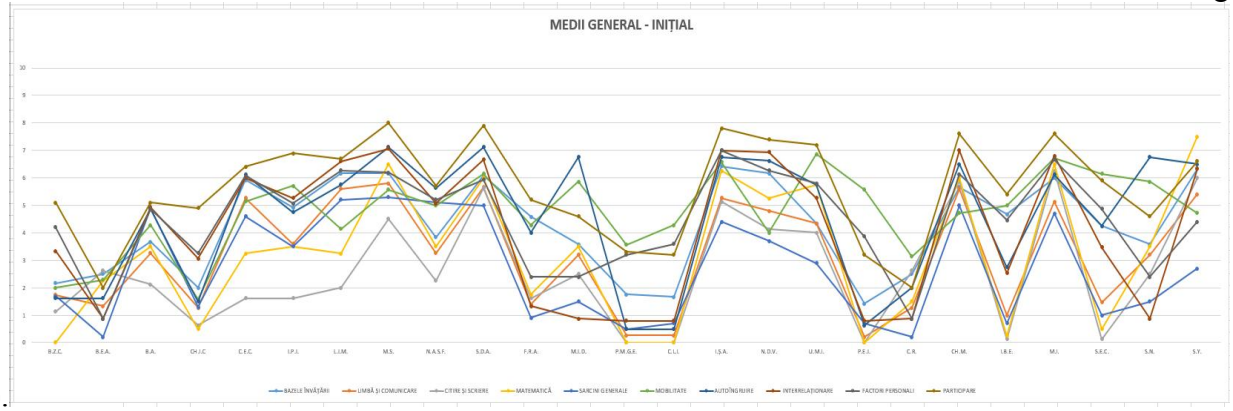

Figure 2. Analysis of pre-experimental results within the ICF functional profile

The chart presents the mean scores obtained by each of the 25 students in the ten areas included in the initial functional assessment (pretest), conducted using the ICF-Map Screening. The analysis of the graphical representation highlights differences both between students and across the areas evaluated for the same student, outlining a heterogeneous group from the perspective of their

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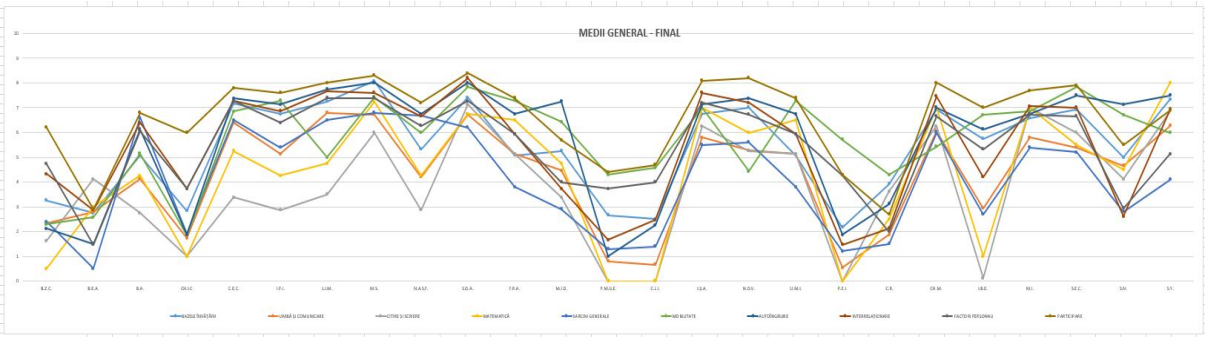
level of functioning at the time of the initial assessment. More pronounced differences between students are observed in the areas of *Mathematics, Reading and Writing, Interpersonal Interaction, Self-Care,* and *Participation*, within which the distribution of individual mean scores indicates variable levels of functioning.



Figur 3. Analysis of pre-experimental results within the ICF functional profile

The chart presents the mean scores obtained by each of the 25 students in the ten areas included in the final functional assessment (posttest). The results highlight the persistence of differences both between students and across the areas evaluated within the same functional profile, with the group maintaining a heterogeneous character from the perspective of their level of functioning. At the individual level, the configuration of the results continues to indicate distinct functional profiles, with differences regarding the level and distribution of scores across the ten analyzed areas. For some students, several dimensions of functioning are situated at relatively similar levels, while for others, more pronounced differences persist between domains with higher results and those in which scores are lower.

Compared to the graphical representation of the initial assessment, a general shift of scores toward higher values is also observed, an aspect which will be analyzed subsequently by comparing the pretest–posttest results. At the individual level, the configuration of the results highlights distinct functional profiles, characterized by variations in mean scores from one area to another. In the case of some students, lower values recorded in certain domains coexist with higher results in other areas, which highlights the particularity of each functional profile. Thus, this supports the necessity of analyzing each case in its entirety and tailoring the educational intervention to the resources and

Item	Mean ± S.D.	S.D.	25th Percentile	Median	75th Percentile	Std. Error	Kurtosis	Skewness
BI 1	4.253 ± 1.706	2.912	2.500	4.333	6.042	0.341	-1.356	-0.261
COM 1	3.183 ± 1.999	3.998	1.300	3.267	5.267	0.400	-1.583	-0.098
CS 1	2.612 ± 2.038	4.154	0.875	2.250	4.313	0.408	-0.983	0.456

support needs identified for each student.

Ma1	3.236 ± 2.449	6.000	0.500	3.500	5.875	0.490	-1.324	0.125
SC 1	2.716 ± 1.911	3.653	0.800	2.700	4.800	0.382	-1.761	0.099
M1	4.766 ± 1.440	2.075	4.071	5.000	5.857	0.288	-0.108	-0.663
A1	4.500 ± 2.359	5.564	1.813	5.625	6.563	0.472	-1.257	-0.593
IR1	4.021 ± 2.527	6.384	0.867	4.933	6.633	0.505	-1.713	-0.172
FP 1	4.491 ± 1.758	3.091	3.233	4.867	6.100	0.352	-0.503	-0.592
P1	5.680 ± 1.840	3.387	4.600	5.900	7.300	0.368	-0.623	-0.624

Table 1. Descriptive statistical analysis of preexperimental data

The analysis of the mean scores obtained pre-experimentally at the sample level highlights differences between the ten functional areas evaluated. The highest mean was recorded for the *Participation* area (*M* = 5.68), followed by *Mobility* (*M* = 4.77), *Self-Care* (*M* = 4.50), *Personal Factors* (*M* = 4.49), and *Foundations of Learning* (*M* = 4.25). Lower mean values were recorded for *Interpersonal Interaction* (*M* = 4.02), *Mathematics* (*M* = 3.24), and *Language and Communication* (*M* = 3.18), with the lowest means identified in the areas of *General Tasks* (*M* = 2.72) and *Reading and Writing* (*M* = 2.61). The analysis of the distribution of results at the initial assessment indicates skewness and kurtosis values that fall within acceptable limits and do not reveal marked deviations in the distributions for the ten analyzed areas.

The comparison of the results presented previously for the two assessment moments highlights an increase in means at posttest for all ten analyzed areas. This trend, also observed in the graphical representations of the initial and final assessments, manifests with varying intensities from one area to another. This normality of the sample distribution allows for the transition to parametric statistics. The largest differences between the means obtained at the two assessment moments were recorded for *General Tasks*, where the mean increased from 2.72 to 4.11, and for *Interpersonal Interaction*, from 4.02 to 5.40. Increases were also observed for *Self-Care* (from 4.50 to 5.68), *Reading and Writing* (from 2.61 to 3.79), *Foundations of Learning* (from 4.25 to 5.39), *Language and Communication* (from 3.18 to 4.31), *Mathematics* (from 3.24 to 4.31), and *Mobility* (from 4.77 to 5.73). For *Personal Factors*, the mean increased from 4.49 to 5.41, and for *Participation*, from 5.68 to 6.60. The descriptive results thus indicate favorable progress between the initial and final assessments across all ten monitored areas. To verify whether the differences observed between the

two assessment moments are statistically significant, the results of the 25 students were analyzed using a paired-samples *t*-test.Table 1. Descriptive statistical analysis of post-experimental data

The analysis of the distribution of results at the final assessment indicates Skewness and Kurtosis values that fall within statistically accepted limits and do not highlight marked deviations in the distributions for the ten analyzed areas. The distribution of these values outlines the general configuration of the sample results at the time of the initial assessment and highlights differences between the mean levels recorded in the ten analyzed areas. These results constitute the initial quantitative benchmark for comparison with the final assessment, conducted after the implementation period of the educational program based on the principles of the Universal Design for Learning (UDL) Curriculum.

Analiza mediilor obținute preexperimental la nivelul eșantionului evidențiază diferențe între cele zece arii funcționale evaluate. Cea mai ridicată medie se înregistrează pentru aria *Participare* (*M* = 5,68), urmată de *Mobilitate* (*M* = 4,77), *Autoîngrijire* (*M* = 4,50), *Factori personali* (*M* = 4,49) și *Bazele învățării* (*M* = 4,25). Valori medii mai reduse sunt înregistrate pentru *Interrelaționare* (*M* = 4,02), *Matematică* (*M* = 3,24) și *Limbă și comunicare* (*M* = 3,18), cele mai scăzute medii fiind identificate în ariile *Sarcini generale* (*M* = 2,72) și *Citire și scriere* (*M* = 2,61).

Analiza distribuției rezultatelor la evaluarea inițială indică valori ale asimetriei (*skewness*) și ale curtozei (*kurtosis*) ce se încadrează în limite acceptabile și nu evidențiază abateri accentuate ale distribuțiilor pentru cele zece arii analizate.

Analiza mediilor obținute la evaluarea finală evidențiază diferențe între cele zece arii funcționale analizate. Cea mai ridicată medie se înregistrează pentru *Participare* (*M* = 6,60), urmată de *Mobilitate* (*M* = 5,73), *Autoîngrijire* (*M* = 5,69), *Factori personali* (*M* = 5,41), *Interrelaționare* (*M* = 5,40) și *Bazele învățării* (*M* = 5,39). Valori medii mai reduse se înregistrează pentru *Limbă și comunicare* și *Matematică* (ambele *M* = 4,31), respectiv *Sarcini generale* (*M* = 4,11), cea mai redusă medie fiind identificată în aria *Citire și scriere* (*M* = 3,79).

Item	Mean ± S.D.	S.D.	25th Percentile	Median	75th Percentile	Std. Error	Kurtosis	Skewness
BI2	5.393 ± 1.839	3.381	3.583	5.333	6.958	0.368	-1.154	-0.449
COM 2	4.312 ± 2.026	4.106	2.567	5.133	5.933	0.405	-0.875	-0.626
CS 2	3.787 ± 2.316	5.362	2.188	3.625	6.000	0.463	-1.045	-0.272
Ma2	4.312 ± 2.580	6.654	1.750	4.750	6.625	0.516	-1.096	-0.485
SC 2	4.108 ± 2.091	4.371	2.150	4.100	6.100	0.418	-1.471	-0.231

M2	5.726 ± 1.719	2.956	4.500	6.000	7.143	0.344	-0.032	-0.867
A2	5.685 ± 2.434	5.922	2.688	6.750	7.375	0.487	-0.830	-0.986
IR 2	5.400 ± 2.215	4.906	3.300	6.400	7.233	0.443	-1.310	-0.536
FP2	5.411 ± 1.734	3.005	4.000	5.933	6.733	0.347	-0.340	-0.766
P2	6.604 ± 1.675	2.805	5.600	7.200	7.950	0.335	0.217	-1.075

Table 2. Descriptive statistical analysis of postexperimental data

The analysis of the means obtained at the final assessment highlights differences between the ten functional areas analyzed. The highest mean was recorded for *Participation* (M = 6.60), followed by *Mobility* (M = 5.73), *Self-Care* (M = 5.69), *Personal Factors* (M = 5.41), *Interpersonal Interaction* (M = 5.40), and *Foundations of Learning* (M = 5.39). Lower mean values were recorded for *Language and Communication* and *Mathematics* (both M = 4.31), respectively, with the lowest mean identified in the *Reading and Writing* area (M = 3.79).

The analysis of the distribution of results at the final assessment indicates skewness and kurtosis values that fall within statistically accepted limits and do not reveal marked deviations in the distributions for the ten analyzed areas. The distribution of these values outlines the general configuration of the sample results at the moment of the initial assessment and highlights differences between the mean levels recorded in the ten analyzed areas. These results constitute the initial quantitative benchmark for comparison with the final assessment, conducted after the implementation period of the educational program based on the principles of the Universal Design for Learning (UDL) Curriculum.

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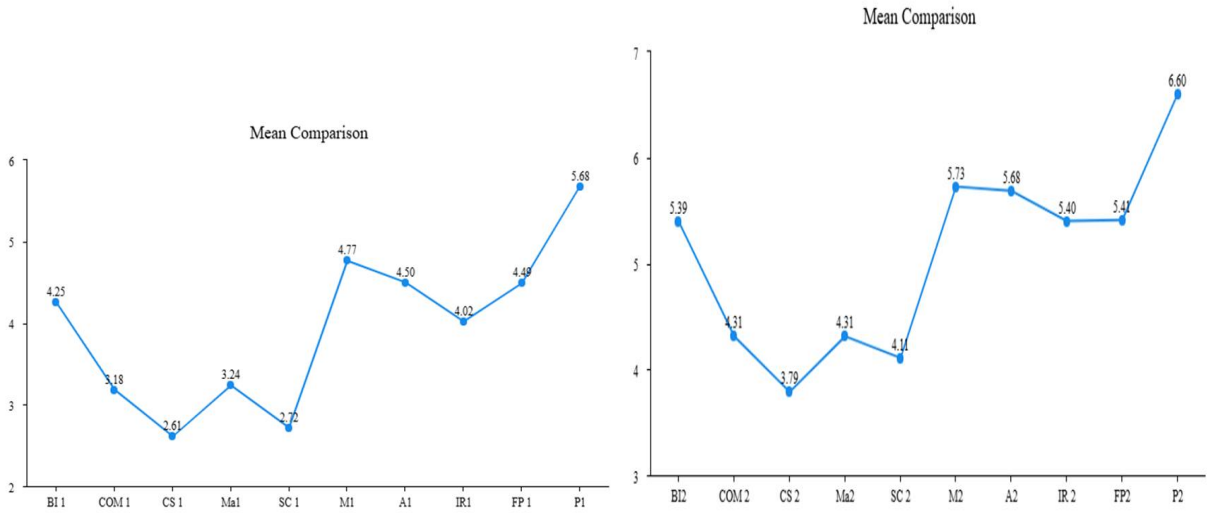

Figure 4. Comparative presentation of pre- and post-experimental mean results

The graphical representation of the means obtained at the initial assessment highlights differences between the ten functional areas analyzed. The lowest mean values were recorded for *Reading and Writing* (M = 2.61) and *General Tasks* (M = 2.72), followed by *Language and Communication* (M = 3.18) and *Mathematics* (M = 3.24). At the upper level of the distribution, *Participation* (M = 5.68) was positioned as the area with the highest mean at the time of the initial assessment. Relatively higher means were also recorded for *Mobility* (M = 4.77), *Self-Care* (M = 4.50), *Personal Factors* (M = 4.49), and *Foundations of Learning* (M = 4.25). The graphical configuration thus highlights the differentiated nature of the initial results across the ten areas, providing a synthetic representation of the mean functional levels identified in the sample prior to the implementation of the educational program based on the principles of the Universal Design for Learning Curriculum.

The configuration of the posttest results highlights the persistence of differences between the ten evaluated areas. The results obtained at the final assessment serve as the benchmark for comparative analysis with the initial level and for examining the progress recorded after the implementation period of the educational program based on the principles of the Universal Design for Learning Curriculum. In the post-experimental assessment, the *Reading and Writing* area recorded the lowest mean (M = 3.79), remaining at a lower level compared to the other evaluated areas. *Participation* continues to represent the area with the highest mean (M = 6.60). Compared to the initial assessment, the graphical representation indicates an increase in mean values, an aspect which will be analyzed by comparing the results obtained at the two assessment moments.

The comparison of the results presented previously for the two assessment moments highlights an increase in means at posttest for all ten analyzed areas. This trend, also observed in the graphical representations of the initial and final assessments, manifests with varying intensities from one area to another. This normality of the sample distribution allows for the transition to parametric statistics. The largest differences between the means obtained at the two assessment moments were recorded for *General Tasks*, where the mean increased from 2.72 to 4.11, and for *Interpersonal Interaction*, from 4.02 to 5.40. Increases were also observed for *Self-Care* (from 4.50 to 5.68), *Reading and Writing* (from 2.61 to 3.79), *Foundations of*

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Learning (from 4.25 to 5.39), *Language and Communication* (from 3.18 to 4.31), *Mathematics* (from 3.24 to 4.31), and *Mobility* (from 4.77 to 5.73). For *Personal Factors*, the mean increased from 4.49 to 5.41, and for *Participation*, from 5.68 to 6.60.

The descriptive results thus indicate favorable progress between the initial and final assessments across all ten monitored areas. To verify whether the differences observed between the two assessment moments are statistically significant, the results of the 25 students were analyzed using a paired-samples *t*-test.

Paired t Test

Item	Paired (Mean ± S.D.)		Mean Difference	*t*	*p* Value
	Pair 1	Pair 2			
BI 1 *Pairing* BI2	4.25 ± 1.71	5.39 ± 1.84	-1.14	-10.599	0.000**
COM 1 *Pairing* COM 2	3.18 ± 2.00	4.31 ± 2.03	-1.13	-6.169	0.000**
CS 1 *Pairing* CS 2	2.61 ± 2.04	3.79 ± 2.32	-1.17	-4.750	0.000**
Ma1 *Pairing* Ma2	3.24 ± 2.45	4.31 ± 2.58	-1.08	-4.395	0.000**
SC 1 *Pairing* SC 2	2.72 ± 1.91	4.11 ± 2.09	-1.39	-8.420	0.000**
M1 *Pairing* M2	4.77 ± 1.44	5.73 ± 1.72	-0.96	-6.771	0.000**
A1 *Pairing* A2	4.50 ± 2.36	5.68 ± 2.43	-1.18	-6.450	0.000**
IR1 *Pairing* IR 2	4.02 ± 2.53	5.40 ± 2.21	-1.38	-6.711	0.000**
FP 1 *Pairing* FP2	4.49 ± 1.76	5.41 ± 1.73	-0.92	-6.423	0.000**
P1 *Pairing* P2	5.68 ± 1.84	6.60 ± 1.67	-0.92	-7.892	0.000**

* $p < 0.05$ ** $p < 0.01$

Table 3. Analysis of pre- and post-experimental mean results using the paired-samples *t*-test

The results of the paired-samples *t*-test reveal statistically significant differences between the initial and final assessments across all ten analyzed areas ($p < .001$). Across all areas, posttest mean scores were higher than those recorded at pretest, statistically supporting the growth trend observed at the descriptive level. The largest mean differences were recorded for *General Tasks* (1.39 points) and *Interpersonal Interaction* (1.38 points), followed by *Self-Care* (1.18 points), *Reading and Writing* (1.17 points), *Foundations of Learning* (1.14 points), *Language and Communication* (1.13 points), and *Mathematics* (1.08 points). Smaller, yet statistically significant increases were recorded for *Mobility* (0.96 points), *Personal Factors* (0.92 points), and *Participation* (0.92 points). Thus, the increases identified descriptively between the two assessment moments are substantiated by the results of the statistical analysis.

CONCLUSION

The analysis of the 25 case studies highlights the existence of heterogeneous functional profiles at the time of initial assessment, with differences observable both among students and across the functional domains of individual students. The data recorded in the case studies reveal varying

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levels of achievement and autonomy, as well as difficulties of varying intensity in learning, communication, task performance, social interaction, and participation. Under these conditions, the progress of each participant was measured against their own initial functional baseline. Comparing the initial and final results indicates favorable progress across the entire sample. The greatest increases in mean scores were recorded in the *General Tasks* domain (from M = 2.72 to M = 4.11) and in *Interpersonal Interactions* (from M = 4.02 to M = 5.40). Significant improvements were also observed in *Self-Care*, *Reading and Writing*, *Foundations of Learning*, and *Language and Communication*.

These results suggest that the most pronounced changes were concentrated specifically on the students' capacity to respond to task demands, perform tasks, interact with others, and utilize functional and learning skills more efficiently. The data within the case studies, as highlighted by the functional profile, support this general trend. At the final assessment, varying degrees of improvement were recorded in engagement in activities, the capacity to maintain and complete tasks, the development of functional communication, the expansion of social interactions, the consolidation of academic achievements, and increased autonomy in daily activities.

However, the progress neither followed the same magnitude nor exhibited the same configuration for all participants. For students who started from lower functional levels, progress was expressed through the acquisition of basic functional skills and increased participation in activities, whereas for students with more developed initial competencies, observations indicated the consolidation of these skills, their expansion, and more autonomous application in educational and daily contexts.

The results of the paired-samples *t*-test support the changes highlighted by the descriptive comparison and the case studies, with the differences between the initial and final assessments being statistically significant across all ten analyzed domains ($p < .001$). These results indicate a systematic evolution of scores between the two assessment points, transcending the individual differences present within the sample. Viewed together, the results of the functional profile, the statistical analysis, and the information derived from the 25 case studies outline a favorable development of the participants following the implementation period of the experimental program based on the principles of Universal Design for Learning. Progress is more evident, in terms of mean differences, in task performance and interpersonal interaction, accompanied by developments in autonomy, learning, communication, and academic achievement. At the same time, the functional profile demonstrates that the pace and magnitude of changes remained individual, and that some difficulties and support needs persisted at the final assessment, in line with the heterogeneity of the initial functional profiles.

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