

## Development and Validation of an Executive Functions Package and Determination of Its Effectiveness on Communication Skills and Self-Care in Adolescents Aged 14–20 Years with Developmental Intellectual Disability

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### ABSTRACT

This study aimed to develop and validate a cognitive rehabilitation package targeting executive functions and to determine its effectiveness on communication skills and self-care in adolescents aged 14–20 years with developmental intellectual disability. The research employed a mixed-methods (qualitative–quantitative) design. In the qualitative phase, the executive functions cognitive rehabilitation intervention package was developed through a systematic review and concurrent meta-analysis of articles indexed in scientific databases published between 2014 and 2024, and its content was subsequently approved by experts in the field. In the quantitative phase, using a quasi-experimental method with a pretest–posttest control group design, 30 adolescents with intellectual disability enrolled in special education schools in Kashan County were selected through convenience sampling and randomly assigned to experimental and control groups (15 participants per group). The intervention program was implemented in 12 one-hour sessions. Data in the qualitative phase were collected using library and documentary methods and interviews, and in the quantitative phase using the Emotion Regulation Questionnaire by Hoffman and Kashdan (2010) and the National Adaptive Behavior Scale developed by Malekshahi, Kamkari, and Makvandi (2018). The validity of the developed package was examined using thematic analysis, and its effectiveness was analyzed using analysis of covariance (ANCOVA) in SPSS version 24. The findings indicated that the mean Content Validity Ratio (CVR) and Content Validity Index (CVI) of the developed package were 0.62 and 0.79, respectively, demonstrating adequate validity of the designed intervention. Statistical results showed significant improvements in self-care and communication skills at the posttest stage in the experimental group compared with the control group. Therefore, it can be concluded that the executive functions rehabilitation package is effective in improving self-care and communication skills in adolescents with developmental intellectual disability and can be utilized to enhance these competencies in this population.

**Keywords:** self-care; executive functions; intellectual disability

## 1. Introduction

Adolescence represents a critical developmental period characterized by rapid biological, cognitive, emotional, and social changes. For adolescents with developmental intellectual disabilities (DID), these transitions are often accompanied by pronounced challenges in adaptive functioning, emotional regulation, communication, and independent self-care. Intellectual disability is typically associated with limitations in intellectual functioning and adaptive behavior, affecting conceptual, social, and practical domains of life. During adolescence, increasing environmental demands—such as academic expectations, social relationships, and emerging autonomy—place additional pressure on cognitive control systems that may already be compromised in this population. Consequently, identifying evidence-based intervention frameworks that can enhance adaptive functioning and psychosocial competencies in adolescents with DID has become a priority in contemporary psychological and educational research (Mumbardó-Adam et al., 2023; Tuffrey-Wijne & McEnhill, 2008).

One of the most influential cognitive constructs linked to adaptive functioning is executive function (EF). Executive functions refer to a set of higher-order cognitive processes that enable goal-directed behavior, including planning, inhibition, working memory, cognitive flexibility, organization, and self-monitoring. These processes are essential for regulating behavior and emotions, solving problems, maintaining attention, and adapting to changing environmental demands. Empirical evidence consistently demonstrates that deficits in executive functions are highly prevalent among individuals with intellectual disabilities and are strongly associated with difficulties in communication, emotional self-regulation, academic engagement, and daily living skills (Gómez-Pérez & Calero, 2023; Schworer et al., 2022). During adolescence, when EF systems are still developing, impairments in these functions may have particularly far-reaching consequences for psychosocial adjustment and long-term quality of life.

Communication skills constitute a core area of difficulty for adolescents with DID. Effective communication requires the integration of multiple executive processes, including working memory for maintaining conversational content, inhibitory control to regulate impulsive responses, and cognitive flexibility to shift perspectives during social interactions. Research indicates that adolescents with intellectual disabilities often exhibit limited expressive and

receptive language abilities, reduced pragmatic competence, and difficulties in social communication, which in turn contribute to social isolation, behavioral problems, and reduced participation in educational and community settings (Babiak, 2020; Howard et al., 2023). Importantly, executive dysfunction has been identified as a key cognitive mechanism underlying these communication challenges, suggesting that interventions targeting executive processes may indirectly enhance communicative competence.

In parallel, self-care and personal independence represent fundamental components of adaptive behavior and developmental outcomes in adolescents with DID. Self-care skills encompass a broad range of daily living activities, including personal hygiene, health-related behaviors, emotional self-management, and safety awareness. Limitations in these domains not only restrict autonomy but also increase vulnerability to health risks and social marginalization. Prior studies have shown that self-care deficits are closely linked to weaknesses in executive functioning, particularly planning, self-monitoring, and inhibitory control (Asrofin & Kristiana, 2023; Peña-Farfán et al., 2023). Therefore, strengthening executive functions may provide a cognitive foundation for improving self-care behaviors and promoting greater independence during adolescence and beyond.

Emotional self-regulation is another critical domain that intersects with executive functioning, communication, and self-care. Emotional self-regulation refers to the ability to monitor, evaluate, and modify emotional responses in a manner that is adaptive and contextually appropriate. Adolescents with DID frequently experience heightened emotional reactivity, difficulties in emotion regulation, and challenges in coping with stress, which may manifest as anxiety, impulsivity, or maladaptive behaviors. Contemporary models emphasize that emotional regulation is not solely an affective process but is deeply embedded in executive control systems, including attentional regulation, cognitive reappraisal, and inhibitory control (Sargolzaei et al., 2018; Seymour, 2025). Accordingly, interventions that integrate executive function training with emotional regulation strategies may yield more comprehensive and sustainable outcomes.

Over the past decade, a growing body of intervention research has examined the effectiveness of executive function training programs for children and adolescents with neurodevelopmental disorders. Studies involving populations with autism spectrum disorder, attention-deficit/hyperactivity disorder, learning disabilities, and

intellectual disabilities have demonstrated that targeted EF interventions can lead to improvements in social skills, communication, academic performance, and emotional regulation (Hashemi Razini & Karampour, 2015; Sabzi et al., 2023; Tirkdari et al., 2023). These findings underscore the plasticity of executive processes and their potential as a focal point for rehabilitation-oriented interventions. However, many existing programs are either narrowly focused on academic outcomes or lack systematic validation procedures, limiting their applicability and generalizability to adolescents with DID.

Recent technological advancements have further expanded the scope of EF-based interventions. Digital media, augmented reality (AR), and virtual reality (VR) platforms have been increasingly employed to create engaging, multimodal learning environments tailored to the cognitive and sensory needs of individuals with intellectual and developmental disabilities. Evidence from meta-analyses and scoping reviews suggests that technology-assisted EF interventions can enhance motivation, skill generalization, and functional learning outcomes, particularly in communication and adaptive behavior domains (Baragash et al., 2022; Bauer et al., 2023; Chiappini et al., 2024). Nevertheless, the effectiveness of such approaches depends heavily on the theoretical coherence, cultural relevance, and psychometric validity of the underlying intervention packages.

Despite the growing interest in executive function interventions, several gaps remain in the literature. First, many studies have examined isolated EF components without integrating them into a comprehensive, structured training package aligned with the real-life needs of adolescents with DID. Second, limited attention has been paid to the systematic development and content validation of EF intervention programs prior to outcome evaluation. Third, while communication skills and emotional regulation have received considerable research attention, self-care as a functional outcome of EF training has been relatively underexplored, particularly within adolescent populations (Mumbardó-Adam et al., 2023; Peña-Farfán et al., 2023). Addressing these gaps requires an integrative approach that combines rigorous qualitative development processes with quantitative evaluation of effectiveness.

Another important consideration concerns the broader psychosocial and contextual factors influencing intervention outcomes. Adolescents with DID often rely on structured educational environments and family support systems to acquire and maintain adaptive skills. Research highlights the

importance of designing interventions that are feasible within special education settings and responsive to caregiver and practitioner needs (Mejvar et al., 2024; O'Flanagan & Nicolson, 2023). Furthermore, interdisciplinary perspectives emphasize that executive function training should not be viewed in isolation but rather as part of a holistic empowerment framework that supports autonomy, self-determination, and quality of life (Mumbardó-Adam et al., 2023; Northrup, 2025).

From a theoretical standpoint, contemporary models conceptualize executive functions as central mechanisms linking cognitive control, emotional regulation, and adaptive behavior. Multifactorial frameworks propose that improvements in EF can cascade into multiple developmental domains, including communication fluency, self-care competence, and emotional stability (Gitit, 2020; Pasqualotto & Venuti, 2020). Empirical studies have supported these models by demonstrating associations between EF components—such as working memory and inhibitory control—and language processing, conversational abilities, and daily functioning (Gómez-Pérez & Calero, 2023; Howard et al., 2023). However, translating these theoretical insights into structured, validated intervention packages remains an ongoing challenge.

In light of these considerations, there is a clear need for research that systematically develops, validates, and evaluates an executive functions training package tailored to adolescents with developmental intellectual disabilities. Such a package should be grounded in empirical evidence, informed by expert consensus, and designed to address core functional outcomes, including communication skills and self-care. By employing a mixed-methods approach that integrates qualitative content analysis with quantitative effectiveness testing, it is possible to generate robust evidence regarding both the construct validity and practical impact of EF-based interventions (Kim & Chung, 2023; Mejvar et al., 2024; Rachma & Hendrawan, 2025).

Therefore, the present study aims to develop and validate an executive functions training package and to determine its effectiveness in improving communication skills and self-care among adolescents aged 14–20 years with developmental intellectual disability.

## 2. Methods and Materials

### 2.1. Study Design and Participants

The research method in this study was a mixed-methods (qualitative–quantitative) design. In the quantitative phase,

the statistical population consisted of all adolescents aged 14–20 years with intellectual disability at the pre-vocational and vocational levels who were enrolled in special education schools in Kashan County. From this population, 30 adolescents with intellectual disability who met the inclusion criteria were selected through purposive sampling and were randomly assigned to experimental and control groups (15 participants in each group). In this study, the qualitative and quantitative approaches were integrated through the development of an executive functions package. The research was conducted in two phases with the aim of developing and validating an executive functions package and determining its effectiveness on emotional self-regulation, communication skills, and self-care in adolescents aged 14–20 years with developmental intellectual disability.

In the qualitative phase, the research population included texts, books, articles, and dissertations related to executive functions, as well as psychology specialists and adolescent therapists. Using purposive sampling, all available sources and studies conducted in the field of executive functions from 2014 to 2024 were reviewed. In addition, 10 experts were selected to evaluate and provide specialized feedback on the designed protocol. In the quantitative phase, the population consisted of all adolescents aged 14–20 years with developmental intellectual disability enrolled in secondary-level special education schools in Kashan City. The sample was selected using convenience sampling and randomly assigned to experimental and control groups (15 participants per group). Data collection methods in the qualitative phase included library-based research and interviews, whereas in the quantitative phase the following questionnaires were used.

## 2.2. Measures

**Communication Skills Questionnaire:** This questionnaire was developed by Barton G. in 1990 to assess communication skills and was standardized in Iran by Moghimi (1997). The Communication Skills Questionnaire consists of 18 items across three domains: verbal skills, listening skills, and feedback skills, with six items in each domain. Items are rated on a five-point Likert scale ranging from strongly disagree (score 1) to strongly agree (score 5). Total scores range from 18 to 90, with a score of 90 indicating the highest level of communication skills. Scores below 42 indicate low communication skills, scores between 42 and 66 indicate moderate communication skills, and

scores above 66 indicate high communication skills. The validity of this questionnaire has been reported as 0.88. Overall reliability, assessed using Cronbach's alpha, was reported as 0.80, and for the three domains of verbal skills, listening skills, and feedback skills, reliability coefficients were 0.71, 0.70, and 0.70, respectively. In a study conducted by Afrooz et al. (2018), this questionnaire was used, and the overall reliability and validity coefficients were reported as 0.77 and 0.82, respectively.

**National Scale of Adaptive Behavior (NSAB):** This instrument was developed by Malekshahi, Kamkari, and Makvandi (2018). It was designed with emphasis on nine instruments, including the Vineland Social Maturity Scale, the Vineland Adaptive Behavior Scale, the Adaptive Behavior Scale, the first edition of the Adaptive Behavior Scale (with emphasis on the school version), the second edition of the Adaptive Behavior Scale (with emphasis on the school version), the Adaptive Behavior Assessment System, the revised version of the Independent Behavior Scales, the second edition of the Battelle Developmental Inventory, and the third edition of the Bayley Scales of Infant and Toddler Development. The instrument was developed as an outcome of the first phase or the product of a think-tank process, and its psychometric properties were examined. During the design process, core components were extracted from multiple scales to construct the instrument based on its internal structure. Accordingly, the design focused on qualitative extraction or identification of the constituent components of each instrument, which was conducted through expert panels and collective expert judgment. In the Bayley scales, greater emphasis is placed on motor behaviors, whereas the Vineland Social Maturity Scale focuses on social adaptation. The integration of multiple instruments while considering cultural contexts was identified as a key innovation of the present study and was conceptualized as the “design” phase. After extracting the main components, items were developed for each component, a process referred to as “item construction.” Design and item construction are considered two interrelated steps involving factor extraction followed by item development. To determine reliability coefficients, split-half reliability with Spearman–Brown correction was used, and test–retest reliability was assessed using Pearson product–moment correlation to examine the correlation between two administrations (test and retest). In addition, discriminant validity was evaluated using the range-of-difference estimation method. Finally, exploratory factor analysis was employed to examine construct (factorial) validity, thereby

identifying the underlying factors of the National Scale of Adaptive Behavior.

### 2.3. Data Analysis

Data were analyzed using a combination of qualitative and quantitative procedures. In the qualitative phase, a systematic review and concurrent meta-analytic approach were employed, followed by qualitative content analysis to extract codes, subcategories, and main categories related to executive functions. Expert judgment was used to assess content validity, and the Content Validity Ratio (CVR) and Content Validity Index (CVI) were calculated. In the quantitative phase, descriptive statistics (means and standard deviations) were computed, and inferential analyses were conducted using multivariate analysis of covariance (MANCOVA) and univariate ANCOVA to examine group differences at posttest while controlling for pretest scores. Assumptions of normality, homogeneity of variances, and homogeneity of regression slopes were tested prior to analysis. All statistical analyses were performed using SPSS (version 24), with the significance level set at  $p < 0.05$ .

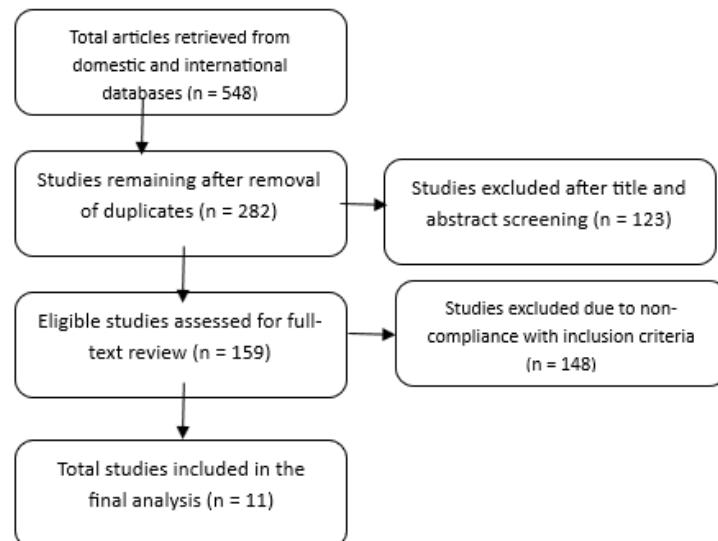
## 3. Findings and Results

In the first step of developing the training package, international articles and theoretical frameworks related to adolescent executive functions—particularly in the domain of emotional self-regulation—published in recent years were reviewed. Given that domestic databases are not sensitive to

Boolean operators, the search was conducted using single keywords. Articles were retrieved using keywords such as academic achievement, emotion, emotional self-regulation, executive functions, and related synonyms and similar terms across the target databases, including ScienceDirect, ProQuest, Springer, Emerald, SAGE, ERIC, Google Scholar, Taylor & Francis, and others. The inclusion criteria for selecting articles for the research corpus were the presence of at least one of the specified keywords in the title or abstract, substantive relevance and impact, and statistically significant predictive power for emotional self-regulation. To ensure comprehensiveness of the search, logical operators such as AND, OR, and NOT were also applied. Sources that were anonymous or non-scholarly were excluded from the review. Additional restrictions were imposed regarding the time frame, language (Persian or English), and type of publication (e.g., empirical research articles and systematic reviews). The criteria for selecting articles for analysis specified electronic availability and a publication period between 2014 and 2024 for English-language articles, and between 2014 and 2024 for Persian-language articles. As a result, 548 articles were initially identified as the research population, of which 282 were duplicates. Following title and abstract screening, 123 articles were excluded. The full texts of the remaining 159 articles were then examined, and at this stage, 148 articles were excluded due to non-compliance with the inclusion criteria. Ultimately, 11 articles were selected for final analysis and review (Figure 1).

**Figure 1**

*Process of searching and screening selected articles*

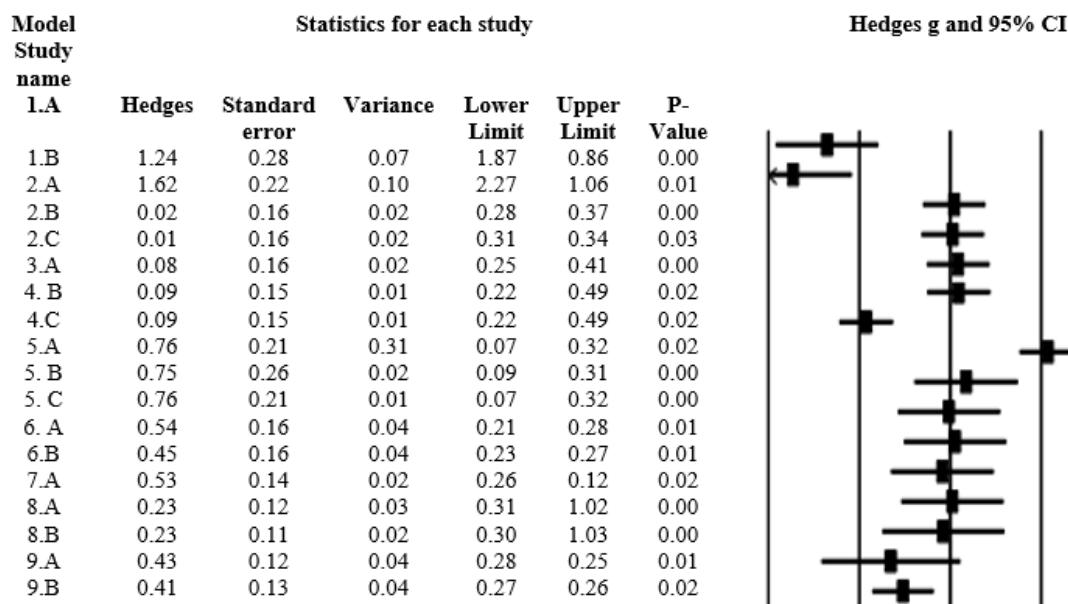


The procedure was conducted such that, based on the greater relevance of articles to the research topic, studies were purposively selected, reviewed, and examined in detail.

Subsequently, factors related to adolescents that predict emotional self-regulation were coded. Table 1 presents the information and characteristics of each reviewed study.

**Table 1**
*Summary of the Studies Reviewed in the Present Research*

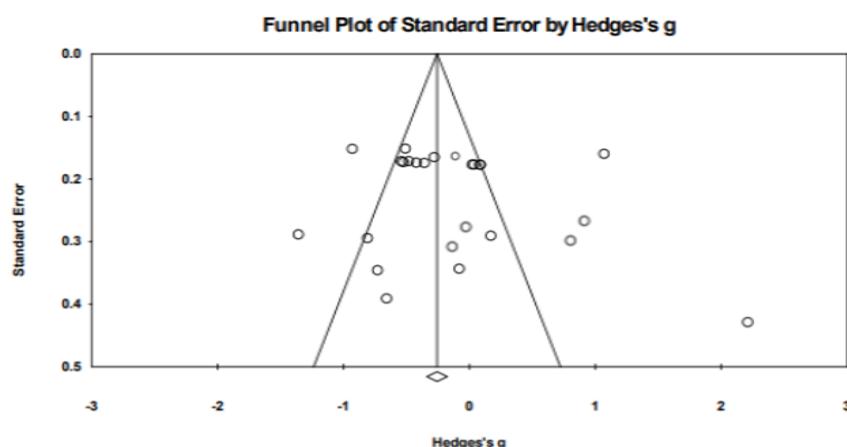
Study	Title	Research Method	Key Findings
Tikdari et al. (2023)	Effectiveness of executive functions training on improving social skills and emotional processing in children with attention-deficit/hyperactivity disorder	Quasi-experimental pretest-posttest	Executive functions were effective in improving social skills and emotional processing.
Soleimani et al. (2022)	Investigating the effectiveness of a manual executive functions enrichment package on communication skills and reading performance of children with reading disorder	Quasi-experimental pretest-posttest	Training the manual executive functions enrichment package was effective in improving social skills and reading performance in children with reading disorder.
Hashemi Razini & Karampour (2014)	Effectiveness of executive functions training on social and communication skills of children with autism spectrum disorder	Quasi-experimental pretest-posttest	Significant differences were observed between the experimental and control groups in social and communication skills at posttest and follow-up. This method can be used as an intervention to reduce clinical symptoms in children with autism spectrum disorder.
Ebrahim Najafabadi Rasoul et al. (2021)	The mediating role of executive functions in the relationship between communication skills and academic achievement in children with learning disorders: A descriptive study	Descriptive correlational	Results indicated that the model of executive functions in predicting mathematics academic skills in elementary students with intellectual disability, controlling for intelligence and age, showed acceptable fit. Significant relationships were found between inhibition, shifting, emotional control, initiation, working memory, planning, organization of materials, monitoring, and mathematics academic skills.
Mojaver et al. (2016)	Effectiveness of an executive functions educational program using augmented reality on communication skills of children with high-functioning autism spectrum disorder	Quasi-experimental	Executive functions training using augmented reality was effective in improving communication skills in children with autism spectrum disorder.
Howard et al. (2023)	The relationship between executive functioning and attentional abilities and language and communication skills in young children with autism	Quasi-experimental	Children with higher executive functioning abilities demonstrated higher social and communication skills.
Kelly et al. (2022)	Examining the effectiveness of executive functioning on children's self-care	Quasi-experimental	Executive functioning skills can support sufficient independence in self-care, including medical self-care and other adaptive skills, thereby increasing the likelihood of a successful transition to adulthood.
Gonsenhauser (2021)	Executive functions training to improve academic performance	Descriptive	Executive functions can improve academic performance through two specific pathways: learning-related behaviors and learning-related cognitions.
O'Toole et al. (2020)	The role of executive functioning in academic achievement, learning-related behaviors, and classroom behavior	Descriptive	Executive functions, particularly working memory, are associated with reading and numeracy performance.
Hutchison et al. (2020)	Parent reports of executive functioning related to communication skills and functional conversation among school-aged children with and without autism spectrum disorder	Quasi-experimental	Executive functions can improve communication skills in children with ASD.
Sorge et al. (2015)	Effectiveness of executive functions training on academic vitality and academic performance of students	Quasi-experimental	Executive functions training was effective in improving academic vitality and academic performance.

**Figure 2**
*Forest plot*


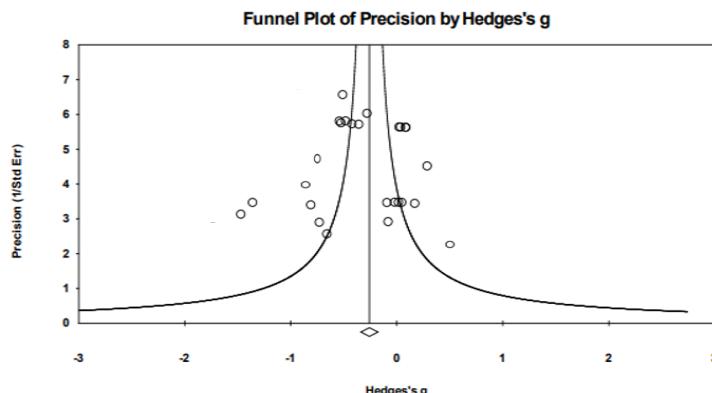
Based on the forest plot of the meta-analysis shown in Figure 2, 16 effect sizes were extracted from 11 studies. By combining the individual effect sizes of each study, a pooled effect size of 0.16 was obtained at a significance level of 0.001. According to Cohen's criteria for interpreting effect sizes in analysis of variance, this represents a large effect size. Therefore, it can be concluded that the studies included in the meta-analysis demonstrate high validity, and the

generalization of the present meta-analytic results to the target population is possible with 99% confidence.

To examine publication bias visually, funnel plots (Figures 3 and 4) were used. A funnel plot displays the study effect size on the horizontal axis as a function of a measure of study precision (typically standard error or inverse variance) on the vertical axis.

**Figure 3**
*Funnel plot of standard error based on Hedges' g index*


**Figure 4**

 Funnel plot of precision based on Hedges' *g* index


Based on the funnel plots of standard error and precision, the distribution of studies indicates symmetry and standardization of the information within the study. The studies are normally and symmetrically distributed on both sides of the zero point of Hedges' *g* index, indicating the absence of publication bias. In addition, inspection of the

funnel plot shows symmetry of studies on both sides of the funnel, further supporting the lack of publication bias. To examine this bias statistically and provide inferential evidence, the Classic Fail-Safe *N* test, Begg and Mazumdar rank correlation test, and the Duval and Tweedie trim-and-fill test were employed.

**Table 2**

 Classic Fail-Safe *N* Test

Statistic	Value
Z value for observed studies	-5.32198
P value for observed studies	0.00000
Alpha	0.04000
Tails	3.00000
Z for alpha	1.86887
Number of observed studies	24
Number of missing studies required to raise p above alpha	225

The Classic Fail-Safe *N* is one of the indices used to assess publication bias and estimates the number of missing studies required to nullify the observed effect. According to the output, the fail-safe *N* was 225, meaning that 225 “null”

studies would need to be identified and included to increase the combined two-tailed *p* value above 0.04; therefore, publication bias is not present.

**Table 3**

Begg and Mazumdar Rank Correlation Test

Statistic	Value
Kendall's S statistic (P-Q)	12.00000
Kendall's tau (without continuity correction)	0.03000
Z value for tau	0.17564
P value (one-tailed)	0.37545
P value (two-tailed)	0.76335
Kendall's tau (with continuity correction)	0.02581
Z value for tau	0.15560
P value (one-tailed)	0.27460
P value (two-tailed)	0.68130

The Begg and Mazumdar rank correlation test is used to assess publication bias by calculating Kendall's tau rank correlation between treatment effect and standard error (study size). Because the p values in both the positive and

negative directions were greater than 0.05, publication bias did not significantly influence the combined effect size in this study.

**Table 4**

*Duval and Tweedie Trim-and-Fill Test*

Trimmed Studies	Effect Model	Point Estimate	Lower Limit	Upper Limit	Q Value
Observed values	Fixed effect	-0.081473	-0.22860	-0.16616	103.06103
	Random effect	-0.16838	-0.40752	-0.03025	
Adjusted values	Fixed effect	-0.081473	-0.22860	-0.16616	103.06103
	Random effect	-0.16838	-0.40752	-0.03025	

Based on the Duval and Tweedie method, the inclusion of missing or unaccounted-for studies on both the right and left sides of the mean did not alter the combined effect size.

After selecting the articles, qualitative content analysis was conducted, and coding was performed. Each code was

organized into 24 subcategories and subsequently into seven main categories, through which the principal components were identified. Table below presents these factors, subcategories, and main categories.

**Table 5**

*Content Coding of Articles Related to the Research Topic and Identification of Categories and Subcategories*

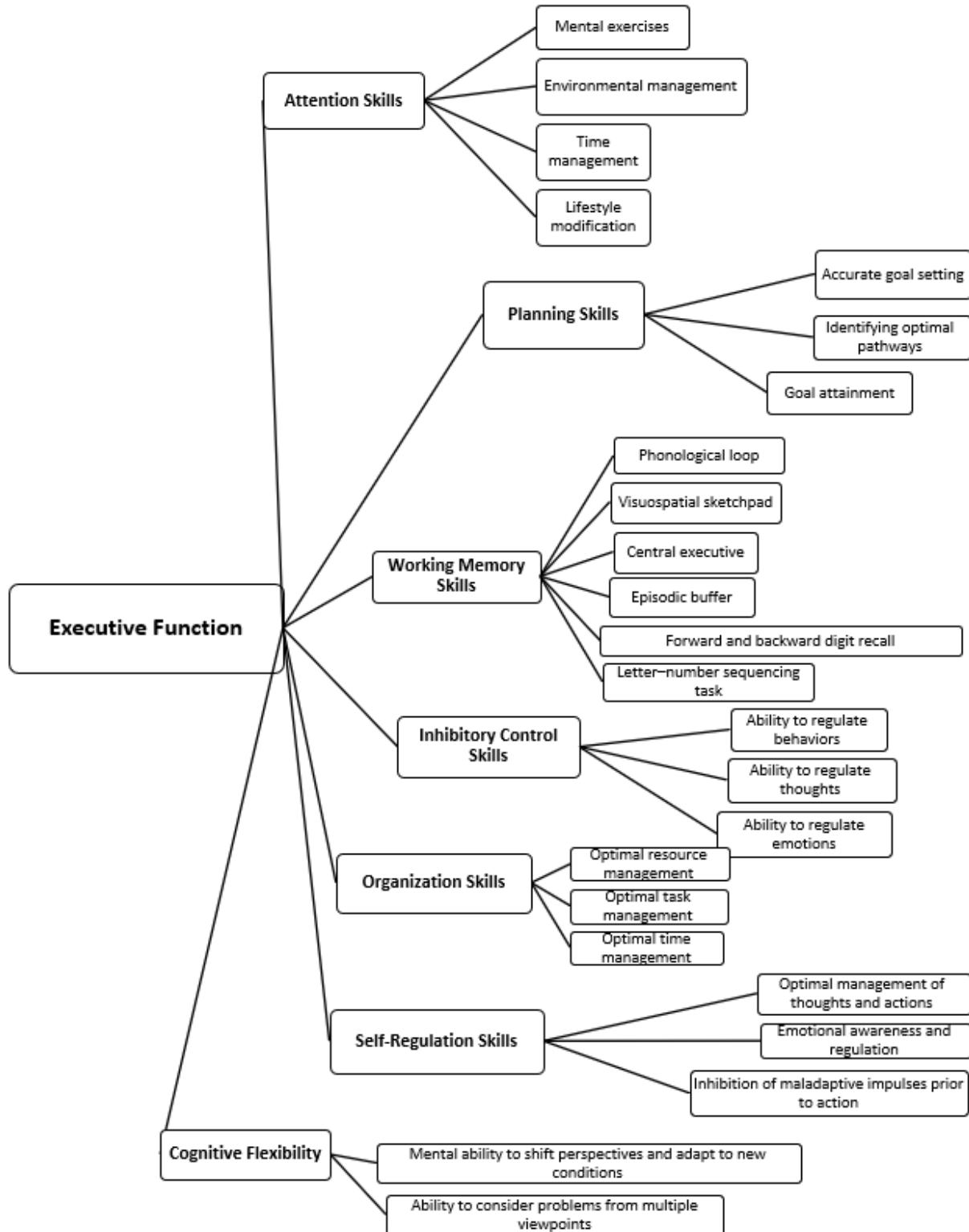
Codes	Subcategories	Main Categories
Deep breathing meditation; mindfulness; organization of the work environment; reduction of digital distractions; setting small goals; regular breaks; appropriate diet; regular exercise; adequate sleep	Mental exercises; environmental management; time management; lifestyle modification	Attention skills
Goal setting; prioritization; time management; evaluation; flexibility; identification of strengths and weaknesses; risk management; understanding current and desired states	Accurate goal setting; searching for optimal pathways; goal attainment	Planning skills
Phonological store; covert rehearsal mechanism; object visualization; route recall; allocation of attentional resources; integration of information from multiple sources	Phonological loop; visuospatial sketchpad; central executive; episodic buffer; forward and backward digit recall; letter-number sequencing task	Working memory skills
Planning; prioritization; time management; delegation; monitoring; information organization	Ability to control behaviors; ability to control thoughts; ability to control emotions	Inhibitory control skills
Planning; goal setting; attention and concentration; problem solving and decision making; critical thinking; self-control; conscientiousness; adaptability; stress management; establishment of desirable behavioral standards; motivation to adhere to standards; internal capacity to control impulses	Optimal resource management; optimal task management; optimal time management	Organization skills
Perceptual shifting; task switching; adaptation to environmental changes	Optimal management of thoughts and actions; ability to think and regulate emotions; control of maladaptive impulses prior to action	Self-regulation skills
—	Mental ability to shift perspectives; adaptability to new conditions; ability to think about issues from multiple viewpoints	Cognitive flexibility

As shown in the above table, following the review and qualitative content analysis of sources during coding, 49 factors were identified. Through axial coding based on thematic similarity, these factors were organized into 24

subcategories and ultimately into seven main categories. Figure below presents the developed model based on the extracted categories.

**Figure 5**

Developed executive functions model based on categories extracted from the available sources



After determining each category and subcategory, the associated objectives were specified in accordance with the research questions. Subsequently, by examining the theoretical background of each component and reviewing authoritative sources in this field, the educational package was developed.

After developing the executive functions educational package, the package was provided to 10 subject-matter experts to validate the factors and indicators of the conceptual framework. The experts expressed their opinions regarding the proposed themes using a dichotomous format (“agree” or “disagree”).

**Table 6**

*Level of Respondents' Agreement With the Themes*

Themes	Agree	Disagree	Agreement Coefficient (%)
Planning skills	10	0	100
Organization skills	8	2	80
Inhibitory control skills	10	0	100
Self-regulation skills	10	0	100
Cognitive flexibility skills	9	1	90
Working memory skills	10	0	100
Attention skills	10	0	100

Given that an agreement level above 70% indicates acceptance of a theme, all proposed themes were approved.

To validate the developed package, the content of the educational package was submitted to 10 experts in psychology, special education, and educational psychology to evaluate the content of each session. The experts were also instructed to consider the appropriateness of wording, grammatical accuracy, importance of items, proper placement of items, and the time required to complete the designed instrument when assessing qualitative content validity. After collecting expert feedback, the necessary revisions were applied. Subsequently, the Content Validity Ratio (CVR)—to ensure selection of the most essential and accurate content—and the Content Validity Index (CVI)—to ensure optimal item design for content measurement—were calculated for all sessions. Considering the size of the

expert panel (10 members), the minimum acceptable CVR and CVI values were 0.62 and 0.79, respectively. The calculated values for all developed sessions were 0.90 and 1.00, confirming the content validity of the educational package.

Based on the collected data, 17 participants were female (56.6%) and the remaining 13 participants were male (43.4%). The majority of participants, 19 adolescents (63.4%), were aged 14–17 years, while 11 participants (36.6%) were aged 18–21 years. Most parents (63.4%) held a bachelor's degree, and the majority of adolescents belonged to families with two to three children (53.4%).

The means and standard deviations of communication skills in the experimental and control groups at the pretest and posttest stages are presented in the following table.

**Table 7**

*Means and Standard Deviations of Communication Skills in the Experimental and Control Groups*

Group	Subscale	n	Pretest Mean	Pretest SD	Posttest Mean	Posttest SD
Experimental	Verbal skills	15	20.57	3.17	27.46	3.14
	Listening skills	15	18.69	2.89	26.28	3.44
	Feedback skills	15	20.32	2.47	28.59	3.65
	Total score	15	61.77	6.44	72.87	7.36
Control	Verbal skills	15	21.17	3.11	21.37	3.09
	Listening skills	15	18.51	2.65	19.06	2.28
	Feedback skills	15	20.76	2.32	21.11	2.62
	Total score	15	60.89	6.51	61.23	6.67

Table above presents the pretest and posttest means and standard deviations of communication skills. As shown, the pretest mean scores of communication skills in the

experimental and control groups were 61.77 and 60.89, respectively. In addition, the posttest mean scores were 72.87 for the experimental group and 61.23 for the control

group. Therefore, communication skills improved in the experimental group at the posttest stage, whereas no substantial change was observed in the control group. Figure

3 illustrates the comparison of these mean scores at pretest and posttest.

**Figure 6**

*Comparison of pretest and posttest communication skills*



As shown in the above figure, there was no notable difference between the experimental and control groups in pretest communication skills; however, the posttest communication skills score of the experimental group was higher than its pretest score.

The means and standard deviations of self-care in the experimental and control groups at the pretest and posttest stages are presented in the following table.

**Table 8**

*Means and Standard Deviations of Self-Care in the Experimental and Control Groups*

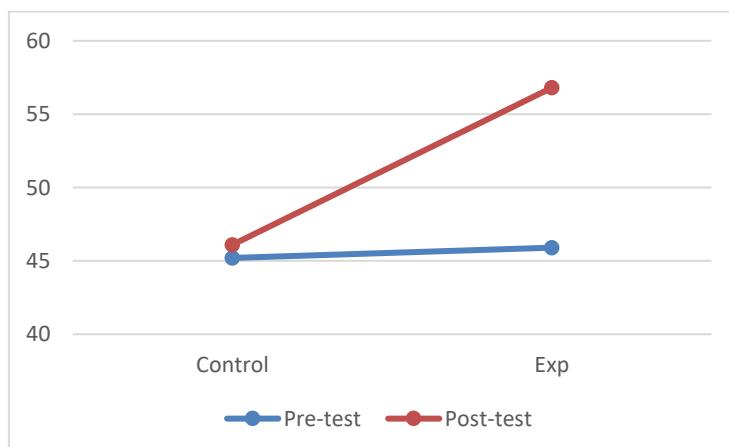
Group	Variable	n	Pretest Mean	Pretest SD	Posttest Mean	Posttest SD
Experimental	Self-care	15	45.22	12.90	56.89	13.19
Control	Self-care	15	45.97	12.94	46.11	12.99

Table above presents the pretest and posttest means and standard deviations of self-care. As shown, the pretest mean scores of self-care in the experimental and control groups were 45.22 and 45.97, respectively. Moreover, the posttest

mean scores were 56.89 for the experimental group and 46.11 for the control group. Figure 4 compares these mean scores at pretest and posttest.

**Figure 7**

*Comparison of pretest and posttest self-care*



As shown in the above figure, there was no substantial difference between the experimental and control groups in pretest self-care scores; however, the posttest self-care score of the experimental group was higher than its pretest score.

To examine whether the pretest–posttest differences within each group were statistically significant, or in other words, whether the implementation of the educational empowerment program for students and parents was effective in increasing academic-related outcomes, appropriate statistical analyses were conducted, which are reported in the inferential analysis section.

Before conducting the analysis of covariance (ANCOVA), its underlying assumptions were examined. Normality was assessed using the Shapiro–Wilk and Kolmogorov–Smirnov tests. When the significance level in both tests exceeds 0.05, the data can be confidently assumed to be normally distributed. Based on the obtained results, the normal distribution of variables at both the pretest and posttest stages across groups was acceptable. The next assumption concerned the homogeneity of variances, which requires that the variances of the groups be equal. This assumption was tested using Levene's test and Box's test. When the significance level is greater than 0.05, the null hypothesis is accepted and the homogeneity of variances is confirmed. Another key assumption is the homogeneity of regression slopes, which is examined to assess whether the relationship between each covariate and the dependent variable is consistent across levels of the independent

variable (i.e., no significant interaction). Specifically, this assumption tests whether the covariate (pretest) interacts with the independent variable (group factor). If the interaction is statistically significant, the assumption of homogeneity of regression slopes is violated. Given that the calculated F coefficients for the interaction between group and pretest were not statistically significant ( $p > 0.05$ ), no significant interaction was observed between the covariates and the independent variable for any of the dependent variables.

The Wilks' lambda results prior to entering the covariates indicated a significant difference between the groups with respect to the dependent variable of emotional self-regulation in posttest scores ( $F = 10.35$ ,  $p = 0.0001$ ). In addition, a significant univariate effect was observed for emotional self-regulation across groups ( $F = 14.49$ ,  $p = 0.0001$ ).

After entering the covariates, the Wilks' lambda results showed that the multivariate effect became considerably stronger. This indicates that the covariates reduced the error variance to some extent ( $F = 18.88$ ,  $p = 0.0001$ , Wilks'  $\lambda = 0.23$ ). Therefore, it can be concluded that the covariates contributed to a reduction in error variance, resulting in a highly significant multivariate effect among groups on the dependent variables at the posttest stage. Table below presents the results of the multivariate analysis of covariance for posttest scores.

**Table 9**

*Results of Multivariate Analysis of Covariance and the Effect of Group Membership on Posttest Scores*

Variable	Source of Variation	Sum of Squares	df	Mean Square	F	Significance Level	Eta Squared
Communication skills	Group	348.74	2	174.37	21.46	0.0001	0.69
	Error	201.56	26	7.75			
Self-care	Group	569.68	2	284.84	23.52	0.0001	0.57
	Error	357.56	26	13.75			

The results for the communication skills variable indicate that after controlling for the pretest effect and based on the calculated F coefficient, a statistically significant difference was observed between the adjusted mean scores of communication skills for participants in the experimental and control groups at the posttest stage. The F ratio, which represents the division of between-group variance by within-group variance, increases as real differences between groups become more pronounced. As shown in above table, the F value for this hypothesis was 21.46, indicating a difference between the experimental and control groups in

communication skills. Given the significance level ( $p = 0.0001$ ), this difference is statistically significant. The magnitude of this effect was 0.69, meaning that 69% of the total variance or individual differences in the improvement of communication skills can be attributed to the executive functions package. Therefore, based on the adjusted means, the null hypothesis is rejected, and the educational package had a greater effect on improving communication skills in the experimental group compared with the control group.

According to the results presented in above table, after controlling for the pretest variable and considering the

calculated F coefficient, a statistically significant difference was observed between the adjusted mean scores of self-care for participants in the experimental and control groups at the posttest stage. The F value for testing this hypothesis was 23.52, indicating a difference between the experimental and control groups in mean self-care scores, which was statistically significant given the significance level ( $p = 0.0001$ ). Therefore, based on the adjusted means, the null hypothesis is rejected, and the executive functions package had a greater effect on increasing self-care in adolescents in the experimental group compared with the control group. The magnitude of this effect was 0.57, indicating that 57% of the total variance or individual differences in self-care improvement can be attributed to this package. Consequently, empowering adolescents through this educational package can lead to improved self-care outcomes.

#### 4. Discussion

The present study aimed to develop and validate an executive functions (EF) training package and to examine its effectiveness in improving communication skills and self-care among adolescents aged 14–20 years with developmental intellectual disability. The findings from both the qualitative and quantitative phases provide convergent evidence supporting the conceptual validity of the developed package and its practical effectiveness. Overall, the results indicate that participation in the EF training program led to statistically significant and practically meaningful improvements in communication skills and self-care in the experimental group compared with the control group, after controlling for pretest scores.

From a quantitative perspective, the multivariate and univariate ANCOVA results demonstrated that group membership had a significant effect on posttest outcomes. Specifically, adolescents who received the EF training package showed substantial gains in overall communication skills and self-care, with large effect sizes ( $\eta^2 = 0.69$  for communication skills and  $\eta^2 = 0.57$  for self-care). These effect sizes suggest that a considerable proportion of variance in post-intervention outcomes can be attributed to the EF-based intervention, highlighting its robustness and educational significance. The absence of significant interaction effects between pretest scores and group membership further supports the conclusion that the observed improvements were not artifacts of baseline differences but rather reflect genuine intervention effects.

The observed improvement in communication skills aligns closely with previous research emphasizing the central role of executive functions in social and communicative competence. Communication requires coordinated engagement of working memory, inhibitory control, attentional regulation, and cognitive flexibility to manage conversational turn-taking, comprehend contextual cues, and regulate impulsive or inappropriate responses. Prior studies have consistently reported that EF training enhances social and communication skills in children and adolescents with neurodevelopmental conditions. For instance, training programs focusing on EF components have been shown to improve social skills and emotional processing in children with attention-deficit/hyperactivity disorder (Tikdari et al., 2023), as well as communication abilities in children with autism spectrum disorder (Haschemi Razini & Karampour, 2015; Howard et al., 2023). The present findings extend this body of evidence to adolescents with developmental intellectual disability, suggesting that EF-based interventions are transferable across diagnostic categories and developmental stages.

The effectiveness of the EF package in improving communication skills may also be interpreted through cognitive–linguistic models that posit executive control as a foundational mechanism supporting language use and pragmatic competence. Empirical evidence indicates that executive processes, particularly working memory and inhibitory control, are associated with verbal fluency, conversational coherence, and pragmatic language use (Babiak, 2020; Gitit, 2020). In this study, the structured training of EF components such as planning, attention, inhibition, and self-regulation likely enhanced participants' capacity to organize thoughts, sustain attention during interactions, and modulate responses, thereby facilitating more effective communication. These results are consistent with findings reported by Gómez-Pérez and Calero, who demonstrated that executive functions significantly predict interpersonal skills in children, independent of general intelligence (Gómez-Pérez & Calero, 2023).

The significant improvement observed in self-care outcomes is another important contribution of the present study. Self-care behaviors, including personal hygiene, health-related routines, and daily living skills, place high demands on executive control systems. Planning daily activities, monitoring task completion, inhibiting maladaptive impulses, and flexibly adjusting behavior in response to contextual demands are all executive processes. Previous studies have highlighted strong associations

between EF deficits and reduced independence in adaptive behavior among individuals with intellectual disabilities (Asrofin & Kristiana, 2023; Mumbardó-Adam et al., 2023). The present findings corroborate these associations and provide experimental evidence that targeted EF training can lead to meaningful gains in self-care.

Notably, the magnitude of the intervention effect on self-care supports multifactorial models of adaptive functioning, which propose that improvements in executive control can cascade into practical life skills. Research by Peña-Farfán and colleagues demonstrated that technology-supported interventions targeting self-care and health-related learning in youth with intellectual disabilities were effective when cognitive control and structured guidance were emphasized (Peña-Farfán et al., 2023). Similarly, the current EF package incorporated structured exercises and goal-oriented activities designed to strengthen self-monitoring, organization, and inhibitory control, which are critical for sustaining self-care routines. These findings also resonate with broader theoretical perspectives suggesting that executive functions serve as a bridge between cognitive abilities and functional independence (Nouwens et al., 2021; Pasqualotto & Venuti, 2020).

The qualitative phase of the study further strengthens the interpretation of the quantitative results. Through systematic review, meta-analytic synthesis, and expert validation, seven core EF domains were identified and integrated into the training package. The high levels of expert agreement and strong content validity indices indicate that the package was theoretically coherent and contextually appropriate. This methodological rigor addresses a common limitation in intervention research, where insufficient attention is paid to content development and validation prior to outcome evaluation. By grounding the intervention in both empirical evidence and expert consensus, the present study enhances the credibility and replicability of its findings (Mejvar et al., 2024; Schworer et al., 2022).

The results also align with emerging evidence on the effectiveness of structured and, in some cases, technology-assisted EF interventions. Although the present study did not directly employ virtual or augmented reality, its findings are consistent with research demonstrating that EF-focused programs—whether delivered through traditional or digital modalities—can yield significant functional gains. Meta-analytic and scoping review evidence suggests that EF interventions, particularly those embedded in engaging and structured learning environments, enhance communication and functional skills in individuals with special needs

(Baragash et al., 2022; Bauer et al., 2023; Chiappini et al., 2024). The current study contributes to this literature by demonstrating that even without advanced technological platforms, a well-designed, validated EF package can produce large effects when implemented systematically.

Another important implication of the findings relates to emotional and behavioral regulation. Although the primary quantitative outcomes reported here focused on communication skills and self-care, the EF domains targeted by the intervention—such as inhibition, attention, and self-regulation—are closely intertwined with emotional regulation processes. Prior research indicates that EF training can reduce emotional dysregulation, test anxiety, and impulsivity in adolescents with learning and developmental disorders (Sabzi et al., 2023; Sargolzaei et al., 2018; Seymour, 2025). It is therefore plausible that the observed improvements in communication and self-care were partly mediated by enhanced emotional regulation, enabling adolescents to engage more effectively in social interactions and daily routines. This interpretation is consistent with pathway models linking EF deficits, emotion dysregulation, and maladaptive outcomes in adolescence (Rachma & Hendrawan, 2025).

The educational and clinical significance of these findings is underscored by the developmental context of adolescence. Adolescents with developmental intellectual disability face increasing expectations for autonomy and social participation, yet often lack access to interventions that address higher-order cognitive control. The present study demonstrates that EF-based training is not only feasible but also highly effective in this age group. Moreover, the group-based implementation format enhances ecological validity and aligns with evidence emphasizing the importance of structured educational environments in promoting skill acquisition among adolescents with developmental disabilities (Mejvar et al., 2024; O'Flanagan & Nicolson, 2023).

## 5. Conclusion

In summary, the discussion of results suggests that the executive functions training package developed in this study has strong empirical support as an effective intervention for improving communication skills and self-care in adolescents with developmental intellectual disability. The findings are consistent with existing theoretical models and empirical studies highlighting the central role of executive control in adaptive functioning. By integrating rigorous content

validation with robust outcome evaluation, the present study contributes meaningful evidence to the growing literature on EF-based interventions and provides a solid foundation for future research and practice.

Despite the strengths of the present study, several limitations should be acknowledged. First, the sample size was relatively small and drawn from a single geographic region, which may limit the generalizability of the findings. Second, the study relied primarily on questionnaire-based measures, which may be subject to response bias or limited sensitivity to subtle behavioral changes. Third, the absence of a follow-up assessment restricts conclusions regarding the long-term sustainability of the observed intervention effects. Finally, potential moderating variables such as family support, severity of intellectual disability, and comorbid conditions were not systematically examined.

Future studies should replicate the present findings using larger and more diverse samples to enhance external validity. Longitudinal designs with follow-up assessments are recommended to evaluate the durability of EF training effects over time. Additionally, future research could examine potential mediating mechanisms, such as emotional regulation or motivation, to clarify how EF training influences communication and self-care. Comparative studies exploring different delivery modalities, including technology-assisted or parent-mediated interventions, may also provide valuable insights into optimizing intervention effectiveness.

From a practical standpoint, educators and clinicians may consider incorporating structured executive function training into educational and rehabilitation programs for adolescents with developmental intellectual disability. The findings suggest that EF-based interventions can be effectively implemented in group settings and may yield broad functional benefits. Practitioners should emphasize consistency, goal-oriented activities, and opportunities for real-life application to maximize skill generalization. Integrating EF training with existing curricula and daily routines may further enhance adolescents' communication abilities and self-care independence.

## Authors' Contributions

Authors equally contributed to this article.

## Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

## Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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## Declaration of Interest

The authors report no conflict of interest.

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The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants.

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