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COGNITIVE EFFECTS AND EMOTIONAL IMPACT OF AN INTERGENERATIONAL INTERVENTION ON OLDER ADULTS AND SCHOOL-AGE CHILDREN

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Abstract:
Intergenerational interventions have traditionally focused on cognitively healthy older adults or those with dementia, with no known studies specifically targeting older adults with Subjective Cognitive Decline (SCD). This study aimed to evaluate the effects of an intergenerational intervention involving both children and older adults with SCD, who participated as "teachers." Twenty-eight retired teachers were divided into three groups: (a) an experimental group, (b) a control group participating in other cognitive training programs, and (c) a control group with no intervention. All participants were affiliated with the Greek Association of Alzheimer's Disease and Related Disorders in Thessaloniki, Greece. Additionally, eighteen 7-year-old students were assigned to either

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an experimental or a control group. Neuropsychological assessments were administered to the older adults, while the children completed tests measuring verbal and non-verbal intelligence. Quantitative results showed that children in the experimental group demonstrated improvements in reading, vocabulary, and mathematical skills. Older adults in the intervention group showed enhanced everyday functional abilities. Qualitative data further revealed a positive emotional response to the program in both age groups. In conclusion, intergenerational interventions appear promising for improving cognitive and functional outcomes in older adults with SCD and cognitive development in young children, while also strengthening intergenerational bonds, promoting mutual understanding, and fostering emotional engagement with the program.

Keywords: intergenerational interventions, subjective cognitive decline, cognitive rehabilitation

1. Introduction

Over the past few decades, intergenerational interventions have gained global attention, with increasing efforts to assess their impact on both children and older adults (Whitehouse, 2013). These interactions are designed to foster meaningful, reciprocal, and constructive relationships, grounded in mutual understanding and respect for one another's needs—ultimately contributing to stronger social bonds and more cohesive communities (Beth Johnson Foundation, 2021). A central aim of such programs is to challenge and deconstruct age-related stereotypes, with numerous reported benefits spanning cognitive, emotional, and social domains. Furthermore, as global life expectancy continues to rise, there is a growing demand for the implementation and broader application of intergenerational interventions, which have demonstrated significant advantages across multiple generations.

Societal stereotypes about aging remain prevalent and often contribute to social isolation among older adults. Brina and Zlata (2024), in their review, suggest that children in early childhood and adolescence tend to hold more negative and stereotypical views of older adults compared to children in middle childhood. Similarly, Aday *et al.* (1996) observed that children begin forming negative perceptions of older adults as early as age five, which become more entrenched by age eight. Addressing the issue of age segregation may lead to meaningful societal change (Canedo-García *et al.*, 2017). In this context, the implementation of intergenerational interventions could play a vital role in challenging age-related biases and fostering intergenerational understanding.

Intergenerational interventions are known to facilitate the transfer of learning outcomes (Gualano *et al.*, 2018; Antoniadou *et al.*, 2021). In particular, a systematic review by Tsiloni *et al.* (2024) highlights that intergenerational learning can provide benefits for both younger and older generations (Lyu *et al.*, 2020). A wide range of intergenerational activities has been implemented, often involving the fine arts—such as dance,

storytelling, and music therapy—as well as Montessori-based activities (Camp *et al.*, 1997; Camp *et al.*, 2005). In some cases, older adults with dementia have led fine arts classes for children, while in other studies, children have been educated about dementia and the needs of individuals living with the condition through volunteer-based activities (Camp *et al.*, 1997; Lee *et al.*, 2007; McNair & Moore, 2010; Gerritzen *et al.*, 2019). Additionally, intergenerational interventions have included recreational activities such as gardening and bingo (Jarrott & Bruno, 2007), board games (Wren, 2004), cognitive enhancement games (Whitehouse, 2013), baking (McNair & Moore, 2010), carpentry, nature walks (George & Singer, 2011; George *et al.*, 2011; Wren, 2004), table tennis (Lewis, 2008), and shared reading (Isaki & Harmon, 2014). Some programs have also focused on direct, person-to-person interaction between generations (Brenner & Brenner, 2012). These interventions have been implemented in a variety of settings, including schools, long-term dementia care units, and nursing homes.

The benefits of both younger and older generations involving intergenerational interventions are frequently positive and specifically for children. Femia *et al.* (2008) reported improvements in social skills, self-regulation in behavior, empathy toward older individuals and social acceptance in second-grade children aged between 6 and 8 years who participated in an intergenerational program, while Gaggioli *et al.* (2014) observed changes in attitudes, fostering more positive perceptions of older adults. Furthermore, Cummings *et al.* (2002) discuss enhancements in academic performance, and Barbosa *et al.* (2020) note increased self-confidence among participants. Intergenerational practices often take place in educational settings, where they appear to play a critical role in fostering healthy engagement between children and their school environment, with long-term benefits (Tsiloni *et al.*, 2024; Sarris *et al.*, 2023). Additionally, Tsiloni *et al.* (2024) found significant social, psychological, and psychosocial benefits of intergenerational interventions, particularly for children in middle childhood.

The following analysis includes participants in both childhood and late adulthood. From a developmental perspective, children between the ages of 6 and 8 undergo significant cognitive changes, shifting from rigid thinking to more flexible and complex thought processes. Their memory capabilities increasingly resemble those of adults (Ornstein *et al.*, 2013), and they become capable of effectively managing verbal dialogue while simultaneously developing reading and writing skills (Sarris *et al.*, 2020a; Schacter *et al.*, 2009). Moreover, executive functions are observed to develop rapidly during this period (Miyake *et al.*, 2000). In a review by Economacou *et al.* (2023), the development of executive functions is discussed alongside their relationship with Theory of Mind. Additionally, Morín and Keulers (2024) identified the mediating role of social interactions in this relationship. Beyond cognitive development, socio-cultural development also plays a critical role, as children begin to form a more mature self-concept and demonstrate increasingly complex moral reasoning (Craig & Baucum, 2007; Sarris *et al.*, 2020b; Christopoulou *et al.*, 2023).

The increase in life expectancy, combined with declining birth rates, highlights the need to explore innovative solutions to the challenges faced by individuals in late

adulthood (Antoniadou *et al.*, 2017). Aging is often associated with fears of diminished vitality, cognitive decline, and reduced functional capacity in daily life (Kostaridou-Eukleidi, 1999). Perspectives on aging vary, and within the scientific community, there is ongoing debate regarding the distinction between healthy aging and its progression into pathological conditions. Nevertheless, a growing body of research on brain physiology suggests that the aging process does not follow a strictly linear trajectory, but is influenced by a range of exogenous and endogenous factors. Exogenous factors include poor dietary habits, environmental pollution, and substance abuse (Livingston *et al.*, 2024), while endogenous factors may involve cardiovascular dysfunction and irregularities in the endocrine system (Christensen & Kumar, 2003). In terms of cognitive processes, aging is linked to observable changes in memory systems (Allen *et al.*, 2002; Craik, 2012; Gazzaley *et al.*, 2007), processing speed (Ritchie *et al.*, 2014), and executive functions (Jiang *et al.*, 2022). Additionally, older adults often encounter challenges in mood regulation, particularly in adapting to the changes that come with aging (Ward *et al.*, 2023). These findings reinforce the view that aging is primarily a biological process, closely intertwined with psychological and social dimensions (Kostaridou-Eukleidi, 1999).

The positive outcomes of intergenerational interventions are not one-sided. Older adults also experience significant benefits, including improved mood and reduced symptoms of depression (Kamei *et al.*, 2011; Sarris *et al.*, 2024), enhanced self-esteem (Teater, 2016), and a stronger sense of purpose through contributing to the younger generation (Herrmann *et al.*, 2005). According to a review by Tsiloni *et al.* (2024), the effects of intergenerational interventions span social, psychological, and psychosocial domains, although findings across studies often vary.

2. Aims and hypotheses

The primary aim of this study is to evaluate the cognitive outcomes of an intergenerational intervention for both older adults and children. Based on the literature discussed above, we propose the following hypotheses:

H1: Children who participate in the intergenerational intervention will demonstrate significant improvements in cognitive performance—specifically in both verbal and non-verbal domains—compared to children who do not participate.

H2: Older adults who take part in the intergenerational intervention will show significant improvements in cognitive functioning and everyday functionality compared to participants in the control groups.

H3: Both groups who participate in the intergenerational intervention will provide positive emotional appraisal about their participation in the intergenerational intervention.

3. Materials and Methods

3.1 Participants

A. The Older Adults' Group

In the present study, a total of twenty-eight retired primary school teachers with Subjective Cognitive Impairment (SCI) participated. On average, they had approximately 30 years of teaching experience. The sample of older adults was divided into three groups: a) the experimental group (n = 9), with a mean age of 67 years (SD = 8.58), b) a control group (n = 9), who had not participated in any cognitive rehabilitation programs, with a mean age of 65 years (SD = 5.15), and c) a second control group (n = 10), who were actively participating in cognitive training programs, with a mean age of 65 years (SD = 4.86).

All participants had received higher education, ranging from 14 to 16 years (SD = 1.5). They were referred to the Greek Association of Alzheimer's Disease and Related Disorders for preventive cognitive health support. Data collection was conducted through a comprehensive neuropsychological assessment administered at the Association's facility—Alzheimer Hellas—in Thessaloniki, Macedonia, Greece. Exclusion criteria included:

a) history of psychiatric disorders (e.g., schizophrenia, depression, anxiety),
b) substance abuse or alcoholism,
c) history of traumatic brain injury,
d) neurological disorders (e.g., Normal Pressure Hydrocephalus, Parkinson's disease, encephalitis, brain tumors, epilepsy, stroke),
e) diabetes,
f) use of medications such as opioids, or medications related to vitamin B12 deficiency and thyroid disorders, and
g) severe sensory impairments (e.g., vision or hearing loss). These criteria were assessed by specialized staff at Alzheimer Hellas.

The Mini-Mental State Examination (MMSE) was used as the baseline cognitive screening measure.

Table 1: Demographic characteristics of older adults

	Age M(SD)	Education M(SD)	MMSE M(SD)
Experimental group	67.00 (8.58)	16.00 (1.50)	28.63 (1.50)
Control group 1*	65.00 (5.15)	16.00 (1.50)	28.86 (.90)
Control group 2*	65.00 (4.86)	16.00 (1.50)	28.89 (1.53)

Note: Control 1 was the control group that did not participate in other forms of cognitive training and Control 2 was the group that participated in other forms of cognitive training.

B. The Students' Group

Eighteen students were randomly allocated into two groups: a) 9 participated in the intervention, and b) 9 formed the control group. All students were in the second grade of elementary school, with an average age of approximately 7 years (M = 7.3 years). The

students were recruited from several primary schools. The criteria to exclude participants were a) the presence of learning disabilities or severe behavioral problems, and b) the presence of Attention Deficit Hyperactivity Disorder (ADHD). To control the exclusion criteria, Raven's CPM and CVS were employed.

Table 2: Demographic characteristics of students

	Mean Age	**Education**	**Raven M(SD)**
Experimental group	7.3	2nd grade	7.11 (1.67)
Control group	7.3	2nd grade	6.91 (.93)

3.2 Procedure

Older adults were required to complete cognitive evaluations, including neuropsychological, behavioral, and medical assessments. This process lasted six months prior to the commencement of the intergenerational intervention. The teachers completed their neuropsychological and medical assessments, which involved two appointments lasting one hour each with specialized doctors and psychologists. Data collection from the older participants was gathered in person at the premises of the Greek Association of Alzheimer's Disease and Related Disorders in Thessaloniki and retrieved from the Association's database. The same evaluation process was repeated after the intergenerational intervention. The groups were formally briefed regarding the intergenerational program and the educational material, and then consent was obtained.

Additionally, school principals, parent-teacher associations, and stakeholders were informed, and then the initial student assessments were conducted and evaluated. This included the randomization of the selection and the formation of intervention and control groups. Moreover, students were submitted to cognitive assessments at the same time in one-to-one evaluation. During the initial evaluation, all potential students were tested using the following scales: Raven's Educational CPM and Raven's Educational CVS (Σιδερίδης και συν., 2015; Raven *et al.*, 1990; 1998). Based on the students' performance on the assessments above, the final sample of students was selected. After completing this process, the students were further evaluated using the WISC-III scales, specifically the subtests for Arithmetic, Vocabulary, Information, and Digit Span (Georgas *et al.*, 1997), as well as the Screening Test of Reading Ability (Tafa, 1995). After the participant selection was completed based on randomization, the intervention process began.

Older adults who participated in this research had completed a previous informative training course before the actual program began. The aim of this training is to make sure that students who took part in the research will receive a good level of education, according to educational methods approved by the Ministry of Education. The lessons were conducted daily, Monday through Friday, for a period of three (3) months, with each session lasting 1.5 hours (from 6:00 PM to 7:30 PM). The sessions took place in a classroom at the Greek Alzheimer's Association in Thessaloniki and covered two subjects each day: mathematics and language. Additionally, it is worth mentioning that every teacher made a major contribution to the procedure. Older adults took

responsibility by successfully completing assignments and several other tasks in the framework of the intergenerational educational lessons. They arrived 30 minutes before the start of the program in order to exchange ideas with their colleagues, discuss student performance, and collaboratively address challenges arising during the teaching process. This setup not only facilitated enhanced coordination and shared strategies among the teachers but also aimed to strengthen their social connections and foster numerous positive emotions, such as self-esteem and solidarity.

3.3 Ethics

Regarding the older adults' group, prior to data collection, consent was obtained from the Ethics Committee of the Greek Association of Alzheimer's Disease and Related Disorders – Alzheimer Hellas. They were informed about the scope of the study and asked whether they would be willing to participate in the intervention. Their personal data, collected before and after the intervention, were securely stored in a separate room at Alzheimer Hellas, where all stakeholders' data are kept. Access to these records was limited exclusively to the researchers and the chief psychologist of Alzheimer Hellas.

For the students' data collection, all ethical and deontological standards were fully upheld, as specified and approved by the Ethics Committee of the University of Ioannina, authorizing the processing of participants' personal data. Specifically, after receiving ethical approval, invitations were sent to primary schools located near Alzheimer Hellas to facilitate easy access for students. Subsequently, school directors met with the researchers, and after receiving detailed information about the study, they informed the students' parents about the intervention. Parents were given the opportunity to ask any questions before granting final permission for their child's participation. The children were also informed about the study and provided their own consent. Students' data were stored securely in the researchers' personal storage spaces on their computers, with access restricted exclusively to the students' parents. All consent forms were documented in writing and are stored together with all participants' scores.

Demographic information, including age, gender, and education level, was collected in accordance with European Union law (effective since 28 May 2018), which permits the use of sensitive personal data for research purposes. Older adults were informed and consented to the fact that, upon written request, their data could be removed from the online database after three years. Similarly, students' data will also be deleted three years after the initial assessment.

The study was conducted in accordance with the principles outlined in the Declaration of Helsinki (World Medical Association, 1997).

3.4 Materials

3.4.1 Older Adults

The neuropsychological assessment was conducted in person. Two sessions, lasting one hour each, to avoid tiring the participants. Initially, screening tests for dementia and mild cognitive impairment were administered, including the Mini Mental State Examination-

MMSE (Fountoulakis *et al.*, 2000) and the Montreal Cognitive Assessment-MoCA (Poptsi *et al.*, 2019). Verbal learning abilities were then evaluated using Rey's Auditory Verbal Learning Test-RAVLT (Messinis *et al.*, 2007). Visual-spatial abilities were assessed with the Rey-Osterrieth Complex Figure Test-ROCFT, which had been adapted to the Greek population by Tsatali *et al.* (2020; Tsatali *et al.*, 2022), while episodic memory was assessed by the Rivermead Behavioral Memory Test (Efklides *et al.*, 2002). Also, verbal fluency was measured using the Greek version of FAS fluency test, which is the X, A, S test (Kosmidis *et al.*, 2004), and executive functions were assessed through the Trail Making Test-Part B-TMT-B (Zalonis *et al.*, 2008). Finally, the participant's ability to complete self-sufficient tasks and achieve daily functionality was evaluated using the Functional Rating Scale for Symptoms of Dementia-FRSSD (Hutton, 1990) and the Functional Cognitive Assessment Scale-FUCAS (Kounti, *et al.*, 2006).

3.4.2 Students

The selected tests for the student participants included diagnostic batteries for learning difficulties and behavioral problems. Specifically, these assessments focused on fluid intelligence and evaluated verbal ability, reasoning, and short-term memory and working memory. The tools used included Raven's Educational CPM and CVS (Σιδερίδης και συν., 2015; Raven *et al.*, 1990; 1998) to assess non-verbal intelligence and verbal ability. Besides, the verbal subscales of the Wechsler Intelligence Scale-III, Greek version (Georgas *et al.*, 1997; Wechsler, 1991), were administered, specifically the subtests for Information, Arithmetic, Vocabulary, and Digit Span. To further evaluate the students' reading ability, the Screening Test of Reading Ability (Tafa, 1995) was also used. In this study, along with quantitative data, an open-ended questionnaire was administered, designed by the research team involved in the project. The questionnaire had been shared with the teachers who participated in the program and the parents of the students. Specifically, the questionnaire included two common questions regarding the benefits of the intergenerational program and the extent to which the students responded to the pilot implementation of the program. Participants, teachers and parents provided their responses using a five-point Likert scale ranging from "not at all" to "very much". Apart from the questions mentioned above, participants were asked to share their emotions elicited by their involvement in the program, as well as to offer suggestions regarding the potential continuation of the intergenerational program in the future.

3.5 Design

The design used in the present study was a Quasi-Experimental design with control groups, specifically a pretest-posttest design. This approach allows us to observe immediate changes in the cognitive abilities of participants involved in the intergenerational intervention compared to the control groups.

4. Results

4.1 Quantitative Analysis

For this analysis, data were collected before and after the intervention. The statistical package IBM SPSS 29 was used. As previously mentioned, the diagnostic assessment that was applied to older adults included a comprehensive neuropsychological evaluation, encompassing memory skills and daily living. To derive statistical results, primarily non-parametric methods were employed. The Friedman test was used to assess the within-group effect of intervention, which is consistent with repeated measurements within the same sample. Furthermore, for the purpose of measuring the effect of the intervention across the three groups, the Kruskal-Wallis test was applied.

Specifically, regarding the older adults' experimental group, the Friedman test indicated statistical significance only for the Functional Rating Scale for Symptoms of Dementia (FRSSD), with χ^2 (1) = 5.00, p = .02. No statistically significant differences were observed for other tests. Subsequently, for the control group that participated in other cognitive assessment programs, the Friedman test revealed statistically significant differences for the ROCFT and RBMT tests. Specifically, for the Rey-Osterrieth Complex Figure Test (ROCFT), which measures the visuospatial memory, a statistically significant difference in performance was observed, with χ^2 (3) = 7.97, p = .04, while for the Rivermead Behavioral Memory Test (RBMT), that measures the episodic memory, the statistically significant difference was χ^2 (3) = 13.09, p = .004. However, for the control group that did not participate in any cognitive reinforcement activities, no statistically significant differences were observed across the various measurements. Finally, the Kruskal-Wallis test did not yield any statistically significant differences between the groups on any of the neuropsychological or behavioral scales used in the analysis.

Table 3: Friedman Test Results for Experimental and Control Groups

Variables	Exp. Group			Control 1			Control 2		
	χ^2	df	p	χ^2	df	p	X	df	p
MMSE	1.00	1	.31	1.00	1	.31	1.00	1	.31
MoCA	.00	1	1.0	1.00	1	.31	3.00	1	.08
RAVLT	3.19	5	.56	9.06	5	.10	9.89	5	.07
ROCFT	4.60	3	.20	6.00	3	.11	**7.97**	**3**	**.04**
RBMT	5.03	3	.16	3.00	3	.39	**13.09**	**3**	**.004**
Fluency X, A, S	.00	1	1.0	1.00	1	.31	1.80	1	.18
TMT-B	1.00	1	.31	1.00	1	.31	1.00	1	.31
FRSSD	**5.00**	**1**	**.02**	1.00	1	.31	3.00	1	.08
FUCAS	.00	1	1.0	1.00	1	.31	.00	1	1.0

Abbreviations: MMSE = Mini Mental State Examination, MoCA = Montreal Cognitive Assessment, RAVLT = Rey Auditory Verbal Learning Test, ROCFT = Rey- Osterrieth Complex Figure Test, TMT-B = Trail Making Test- Part B, FRSSD = Functional Rating Scale of Symptoms of Dementia, FUCAS = Functional Cognitive Assessment Scale.

Consequently, regarding the analysis of the data collected before and after the intervention based on the neuropsychological assessment of the children, a similar reasoning approach was applied. Therefore, non-parametric tests were used for analyzing the data on children assessments. Since the participants were divided in two groups, the Wilcoxon Signed-Rank Test was used to examine intra-group effects, and the Mann-Whitney U Test was applied to assess inter-group effects in the scores that changed.

Intra-group effects of the intervention within the experimental group had statistically significant differences in certain subscales of the WISC-III and the TAFA test. Through the Wilcoxon Signed-Rank Test, a statistically significant difference was identified in the Arithmetic subscale ($Z = -1.99$, $p = .04$), with post-intervention measurements (Mdn = 17.00) being higher than pre-intervention measurements (Mdn = 15.00). Moreover, the test revealed a statistically significant difference in Vocabulary ($Z = -2.22$, $p = .02$), with the median score after the intervention (Mdn = 17.00) surpassing that before the intervention (Mdn = 16.00). Mental age also exhibited a statistically significant difference ($Z = -2.49$, $p = .01$), with higher measurements observed post-intervention (Mdn = 8.70) compared to pre-intervention (Mdn = 8.20). No other statistically significant differences were found in the subtests of the WISC-III. Finally, both the initial and steady-state scores of the STRA test revealed statistically significant differences ($Z = -2.52$, $p = .01$ and $Z = -2.20$, $p = .02$, respectively), with post-intervention scores being higher (Mdn = 30.00 and 104.00, respectively) compared to pre-intervention scores (Mdn = 21.00 and 98.00, respectively).

Regarding the control group, no changes were observed in their performance on the verbal subtests of the WISC-III. The only statistically significant difference noted was in the TAFA test, specifically in the steady-state score. The Wilcoxon test revealed a statistically significant difference for the steady-state score ($Z = -2.52$, $p = .01$), with post-intervention measurements (Mdn = 102.00) being lower than pre-intervention measurements (Mdn = 105.00).

Table 4: Wilcoxon Signed-Ranked test results for intra-group effects

Variables	Experimental group				Control group			
	Z	*p*	pre-Mdn	post-Mdn	Z	*p*	pre-Mdn	post-Mdn
Informations	-.14	.88	13.00	13.00	-.59	.55	11.00	12.00
Arithmetic	-1.99	**.04**	15.00	17.00	-.34	.73	16.00	15.00
Vocabulary	-2.22	**.02**	16.00	17.00	-.98	.32	18.00	14.00
Digit Span	-1.38	.16	10.00	11.00	-.95	.34	11.00	10.00
Mental Age	-2.49	**.01**	8.20	8.70	-.17	.85	8.00	8.10
STRA Initial	-2.52	**.01**	21.00	30.00	-.14	.88	27.00	28.00
STRA Steady	-2.20	**.02**	98.00	104.0	-2.52	**.01**	105. 00	102.00

Likewise, the Mann-Whitney U test was applied to examine inter-group effects on the change scores before and after intervention measurements. Applying this test to change scores was based on their ability to capture the difference in each participant's

performance before and after the intervention. By using change scores, we can directly assess the impact of the intervention on individual performance without separately analyzing each time. Similarly, this approach helps us ensure that the analysis is not affected by pre-existing extraneous variables in each group.

The verbal subtests of the WISC-III showed no statistically significant differences in most cases, except for the Vocabulary subscale. Vocabulary demonstrated a statistically significant difference between the experimental and control groups, with the mean rank of the score of the experimental group being 12.06 and that of the control group being 6.94 (U = 17.5, Z = −2.06, p = .03).

Hence, the same statistical test was applied to the STRA test, which revealed statistically significant differences between the groups in both initial and steady-state scores. Following that, the initial score's change values showed a statistically significant difference, with the mean rank of the experimental group being 12.39 and that of the control group being 6.61 (U = 14.5, Z = −2.31, p = .02). Similarly, the steady-state score's change values also demonstrated a statistically significant difference, with the experimental group having a mean rank of 13.83 and the control group 5.17 (U = 1.5, Z = −3.46, p <.001). Finally, the same test was applied to the Raven scale, where no statistically significant differences were observed between the groups. The Raven scale was only used during the pre-intervention evaluation as a screening tool.

Table 5: Mann-Whitney U Test results for inter-group effects

Variables	Mean Rank				
	Exp. group	Control	U	Z	p
Informations	9.11	9.89	37.00	-.31	.75
Arithmetic	10.72	8.28	29.50	-.98	.32
Vocabulary	12.06	6.94	17.50	-2.06	**.03**
Digit Span	11.28	7.72	24.50	-1.44	.14
Mental Age	11.50	7.50	22.50	-1.59	.11
STRA Initial	12.39	6.61	14.50	-2.31	**.02**
STRA Steady	13.83	5.17	1.50	-3.46	**<.001**
Raven	9.72	9.28	38.50	-.18	.85

4.2 Qualitative Analysis

Based on the responses provided by both older adults and the parents/guardians of the children, the first two questions of the questionnaire allowed for quantitative analysis, as they were rated on a Likert scale from 1 to 4. For the first question—assessing how beneficial participants found the intergenerational intervention—all older adults and all parents/guardians responded, “Very much.” Similarly, in response to the second question—regarding the responsiveness of both older adults and students to the program—both groups again answered unanimously with “Very much.”

The third question focused on the emotional impact of participating in the study. Older adults reported high levels of satisfaction, expressing emotions such as joy and fulfillment, largely stemming from effective communication and collaboration with the program coordinator. Some also mentioned feelings of anxiety about meeting

expectations, as well as eagerness and pride in making a meaningful contribution to the younger generation. Parents and guardians similarly reported feelings of joy and satisfaction with the program's structure and implementation. They also expressed pride in their children's participation and anticipation surrounding the intervention.

The final question asked for suggestions for future initiatives. Older adults proposed expanding such programs beyond research contexts, suggesting wider implementation in schools and longer program duration. Parents and guardians also supported expanding the program into community institutions, recommending flexible scheduling, relevant topics, and the inclusion of creative and play-based activities.

In conclusion, the intergenerational intervention was perceived as highly successful, with parents and guardians expressing strong interest in seeing such educational activities introduced across all schools in Thessaloniki.

5. Discussion

The aim of this study was to examine the extent to which participation in an intergenerational intervention program positively influenced the cognitive and functional abilities of both older adults and students. Specifically, it was hypothesized that older adults in the intervention group would demonstrate statistically significant improvements in cognitive functioning compared to those who either did not participate in any program or were involved in other forms of cognitive training. Improvements in independent living skills were also anticipated. For the students, the primary objective was to compare cognitive gains between the experimental and control groups. Additionally, according to Hypothesis 3, it was expected that both older adults and children would perceive the intergenerational program as beneficial and report positive emotional experiences, as reflected in their responses to self-report questionnaires.

The results of this study revealed several noteworthy findings regarding the students. The experimental group demonstrated statistically significant improvements in performance following the intervention. Specifically, gains were observed in both vocabulary and arithmetic skills. When compared to the control group, the experimental group showed notable differences in reading ability and vocabulary scores. Evaluations from parents and guardians reflected high levels of satisfaction, with many noting that students responded positively to the intervention tasks. They also reported perceived changes in their children's attitudes toward older adults. While this perception is subjective and should be interpreted with caution, it nonetheless suggests a shift in intergenerational attitudes. These results support the hypothesis that the intergenerational intervention had a positive impact on students' academic performance and contributed to more favorable perceptions of aging. The findings are further reinforced by qualitative assessments from parents/guardians and testimonials provided by the students during the program.

Regarding the older adults' group view, a statistically significant change was observed on the FRSSD scale, which investigates aspects of their daily functioning and

various dimensions of cognitive functions. This change was only observed at the intra-group level, with no statistically significant differences noted in control groups. The experimental group actively participated in the intervention program with weekly exchanges, a situation that might be attributed to the results that were made about the FRSSD score between the groups. The other groups, although one of them participated in cognitive training programs, at their majority were implemented for the majority via technological means due to the ongoing Covid-19 pandemic, leaving a small room for social exchanges. Furthermore, the control group that participated in other cognitive rehabilitation programs showed an overall better performance on other cognitive abilities, such as visual perception and memory and in working and episodic memory. These findings align with the results that were proposed by Poptsi *et al.* (2022), referring to the longitudinal effects that cognitive and physical training had on several cognitive abilities. The qualitative analysis further indicated that teachers had a beneficial outcome from the intervention, and they also believed that they met the program's demands sufficiently. From the qualitative analysis they also reported experiencing feelings of joy, emotional resonance, and satisfaction from participating in the intergenerational program. In conclusion, we can confirm our hypotheses and believe that the findings generated through qualitative sampling align with previous literature regarding mood improvement.

Based on the current results and previous literature, some comparisons can be made. However, the relatively small sample size does not allow for any firm conclusions to be drawn. Nevertheless, our findings align with the intergenerational approach implemented by Gaggioli *et al.* (2014). They suggest that the well-being of elderly participants can be improved, and the younger generation's perceptions of aging can be positively influenced. Similarly, we propose that implementing an intergenerational educational program could benefit both older and younger generations. Additionally, Cummings *et al.* (2002) suggested that students showed a change in their academic performance. To an extent, we agree with those results, although different measures were implemented. Positive emotions were also observed by Barbosa *et al.* (2021), after the intervention, while in this case, educators also reported positive emotions from their participation. Most intergenerational interventions aim to change affective aspects of the participants, either their mood (e.g. depressive symptomatology) or their perception (e.g. children's attitude towards older adults), yet some or none aim to enhance cognitive and academic performance in both older adults and children (Tsiloni *et al.*, 2024).

From the qualitative results, educators self-reported that through their participation, they felt a positive emotional shift. Although in this analysis we controlled for mood disorders. Having said that, their affective state was typical before the intervention. Nevertheless, it was a result worth mentioning because it was also observed in previous research (e.g Barbosa *et al.*, 2021). Furthermore, our intergenerational approach was grounded in school-based curricular activities, similar to the methodology used by Cummings *et al.* (2002). To some extent, we agree that this approach can

significantly influence children's attitudes toward older adults. However, our results primarily focus on the cognitive changes observed following the intervention.

In their review, Tsiloni *et al.* (2024) attempted to provide evidence on the psychosocial effects of intergenerational learning on both children and older adults. Our findings suggest that this type of learning can have positive outcomes for both generations, in cognitive and affective domains. While many studies have concentrated on the psychosocial effects of intergenerational interventions, few, if any, have focused on their cognitive outcomes. We believe that future implementations should include this dimension to better understand how these interventions can contribute to the well-being of participants.

In summary, this study provides preliminary evidence of the potential positive effects of an intergenerational program on the cognitive abilities of older adults with Subjective Memory Complaints. The findings underscore the importance of examining multiple parameters, such as cognitive abilities, daily functioning, subjective improvements in memory issues, and overall program satisfaction. Additionally, further research is needed to better understand the underlying mechanisms and long-term effects of such interventions on older adults.

5.1 Limitations, Future Research and Practical Applications

Some limitations were identified in this study. Firstly, the sample size of both teachers and students was marginally small, which did not allow the application of more robust statistical analyses. Future research is recommended to involve a larger number of samples so as to enhance the statistical power and the reliability of findings. Additionally, it is suggested that future studies conduct more extensive qualitative evaluations focusing on the students to better understand their experiences and perspectives through participation in intergenerational interventions. Future efforts should also consider the timetable of the intervention to ensure it has a meaningful impact on both the cognitive and socio-emotional abilities of all the students and the teachers involved.

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Conflict of Interest Statement

The authors declare no conflicts of interest.

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