



ADHD_Wiki_Collaborate Programme: Fostering ADHD Students' Cooperative and Social Skills Using Web 2.0 Tools

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ABSTRACT

The characteristics of Attention Deficit Hyperactivity Disorder (ADHD) have an impact on collaborative and social skills. Web 2.0 tools, when used in psychoeducational activities, contribute to these skills' improvement. This study aims to explore the effectiveness of an intervention programme by using a wiki tool to improve cooperation and socialization skills among peers in class groups where there is at least one student with ADHD. A single-group wiki-based intervention programme was designed and implemented over 15 weeks. Participants were 191 students from a secondary school in Greece, aged 12 and 13 years old. The results showed that ADHD students' preference to group work was enhanced, while their preference to individual work as well as their difficulty of adjustment to group work decreased. Moreover, their cooperative skills and empathy improved, whereas irritability and disturbance decreased. ADHD students with social and cooperative skills' deficits could be benefited from this intervention.

El Programa ADHD_Wiki_Collaborate: el fomento de las habilidades cooperativas y sociales del alumnado con TDAH mediante herramientas Web 2.0

RESUMEN

Las características del trastorno por déficit de atención e hiperactividad (TDAH) repercuten en las habilidades sociales y de cooperación. Las herramientas Web 2.0 cuando se utilizan en actividades psicoeducativas contribuyen a la mejora de estas habilidades. Este estudio pretende explorar la eficacia de un programa de intervención que utiliza una herramienta wiki para mejorar las habilidades de cooperación y sociales entre compañeros en grupos de clase donde hay al menos un alumno con TDAH. Se diseñó e implementó un programa de intervención en un solo grupo, basado en wiki y con una duración de 15 semanas. Los participantes fueron 191 estudiantes de una escuela de Secundaria de Grecia de 12 y 13 años de edad. Los resultados indican que aumentó la preferencia de los alumnos con TDAH por el trabajo en grupo, mientras que disminuyó su preferencia por el trabajo individual, así como su dificultad de adaptación al trabajo en grupo. Además, mejoraron sus habilidades cooperativas y la empatía, mientras que disminuyeron la irritabilidad y perturbación. El alumnado con TDAH con déficit de habilidades sociales y cooperativas podría beneficiarse de esta intervención.

Palabras clave:

TDAH
Herramientas Web 2.0
Wiki
Cooperación
Habilidades sociales

The global prevalence of ADHD among children and adolescents is estimated to be 5-7%, based on multiple studies and meta-analyses (Polanczyk et al., 2007; Thomas et al., 2015). However, this percentage varies across regions and is manifested with diverse symptomatology that impact the school life of children affected. It is known that they want to be included in the group but struggle with developing social behavior (Tan & Cheung, 2008). Technology can support students with ADHD by enhancing their learning abilities and facilitating collaborative efforts.

One of the key changes involved in trying to adapt education to continuous technological developments is the transition from

teaching to learning. For instance, Web 2.0 promotes a new way of participation using user-centred tools and platforms such as blogs, wikis, social networks, content aggregation systems, content-sharing sites, and more.

ADHD and Its Impact on Cooperative and Social Skills

ADHD is a childhood-onset neuro-developmental condition characterized by age-inappropriate levels of inattention, hyperactivity, and impulsivity (Kooij et al. 2010). According to

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the DSM-5 (American Psychiatric Association, 2013) definition, ADHD is divided into three subcategories (Hoseinifar et al., 2011; Koutsoklenis & Honkasilta, 2023): low concentration, hyperactivity – impulsivity, and a combination of the above. It is also added that ADHD is associated with severe difficulties in adjusting, stress, school performance, learning abilities, social interaction, behavior, and other developmental processes.

Children with poor attention skills, in general, respond to a greater number of impulses, whether they are relevant or not to perform the tasks, and do not seem able to concentrate during the necessary time (Mahewash & Nishi, 2014). This can lead to disruptive attitudes that hinder learning and also acceptance by teachers and peers. Another feature that is attributed to children with attention problems is their disorganization and impulsiveness, which leads them to have problems in making decisions and solving problems (Bauermeister et al., 2012).

Despite their need for special educational techniques, ADHD students are not considered as kids with disabilities and they are included in the ordinary classroom. They frequently exhibit less positive social behaviors, initiate fewer positive peer interactions, experience lower rates of peer reinforcement, and demonstrate less cooperative social behaviour (Fenstermacher et al., 2006). Because of their limited interaction and social skills, it is common for them to face rejection in mainstream settings (Cook & Semmel, 1999). Chronic peer relationship difficulties may contribute to future negative outcomes, including substance abuse, and psychopathology (Gardner & Gerdes, 2015). They suffer deep feelings of unworthiness (Armstrong, 1999), low learning motivation, poor self-esteem, behavioural problems, and social rejection (Mustafina et al., 2022). Children with ADHD are often the most rejected among their peers (Zumpfe & Landau, 2002), and many may opt to leave school (Bishop, 2003).

To mitigate these undesired consequences, research has focused on the development of methodologies such as cooperative and project-based learning that are demonstrated by social learning theory and contribute to these students' integration into their classrooms.

Cooperative Learning and Project-based Activities

Collaborative and cooperative learning demonstrate social constructivism, recognized by Vygotsky at the beginning of the 20th century (Vygotsky, 1978). In Vygotsky's view, learning takes place as children depend on collaborative, discourse, and social interaction activities that allow students to develop social and literacy skills, working productively with people from heterogeneous backgrounds and of diverse ability levels (Becker, 1990). Cooperative learning offers an alternative to traditional, instructional, and engaging teaching to increase student academic achievement (Siegel, 2005). Successful implementation requires planned, organized, and structured activities that align with the learning objectives (Halpern, 2011).

Kirschner (2001) identifies key characteristics associated with cooperative learning, emphasizing the active learning process where the teacher transitions to facilitator of learning. In this approach, students actively participate in small-group activities, take responsibility for their own learning, engage in reflective practices, and develop social and team skills.

Project-based learning (PBL) is defined as the teaching technique through which classroom collaboration enables teachers and students to share a discovery process (Wentworth & Davis, 2002). PBL helps students to develop their collaborative and investigating skills with reference to real world problems, adding in this way value to their learning (Solomon, 2003).

The Framework for High-Quality Project-based Learning (High Quality Based Learning, 2018) outlines certain essential criteria defining excellence in projects. Firstly, projects must present

intellectual challenges, authenticity, public product display, discussion, and critique. Collaboration involves in-person or online meaningful engagement with peers, mentors, and experts, emphasizing the collective contribution of diverse skills to a shared work. Reflection is integral, fostering ongoing self-assessment, skill retention, and building students' confidence and control over their education.

In order to facilitate the development of interpersonal and small-group skills a tutorial activity could be designed by software designers, aiming at introducing or refreshing the groupmates' understanding of cooperative skills. Roles to be assigned by the teacher to each group member include keyboarder, recorder, checker for understanding, encourager of participation. The software could be designed to include pauses or it could often remind students to check on their own performance and to assist in optimizing group performance. Group reward is vital to provide a group goal motivating everyone to work well together (Johnson & Johnson, 1996).

Computer-supported Collaborative Learning (CSCL)

Nowadays, the presence of ICT in most everyday activities signifies the need for collaboration and group involvement (Toki & Pange, 2013). The integration of technology in contemporary classroom is useful because it provides learners the chance to develop their communicative skills, learning how to work independently, be creative and flexible (Papadopoulou & Vlachos, 2014). Moreover, a recent meta-analysis (Chen et al., 2018) demonstrated a significant positive effect of collaborative learning versus individual learning on knowledge achievement, skill acquisition, and student perceptions in computer-based settings.

CSCL is the field concerned with how computers might support learning in groups as well as about understanding the actions and activities mediated by the computer in collaborative learning. Social learning is becoming recognized as an important trend in CSCL, especially given the increasing use of social and collaborative learning platforms across different learning settings (Kaliisa et al., 2022). In this context learning takes place via social interaction and involves the sharing and construction of knowledge, with technology being used either as the primary means of communication or simply as a common resource (Vega et al., 2019).

Web 2.0 Tools in Education

Web 2.0 is defined as a more personalized, communicative form of World Wide Web, promoting participation, connection, collaboration and sharing of information and ideas among users. Since Web 2.0 goes beyond its older versions, due to its flexible application design (Murugesan, 2007), it is also called "Reading-Writing Web" (Galustyan, 2019), where the viewable/downloadable content allows the general public to actively contribute to it. Web 2.0 applications, include, but are not limited to, blogs, wikis, really simple syndications (RSS), podcasts, social networking sites, tag-based folksonomies, and peer-to-peer (P2P) media sharing utilities (Ozcinar et al., 2020).

Wiki is a web tool that offers teachers the chance to integrate technology in their lessons encouraging students to engage in collaborative writing tasks (Abrams, 2016), leading them to engage in learner-to-learner interaction (Swain & Lapkin, 2001). It is known for its collaborative nature, ease of use, and effectiveness in fostering collaborating writing (Kolliopoulos, 2011), including the possibility to undo any wrong actions.

Advantages of using wikis in education, as highlighted by Bean and Hott (2005), Lamb (2004), Charles and Ranmi (2007), include ease of use, equal participation opportunities, effective utilization of strengths for collective projects, quick knowledge building, time-

saving, global communication, version history tracking, flexibility, cost-effectiveness, and enhanced communication (Mabrito, 2006).

Despite the growing popularity of web 2.0 technologies in education, challenges regarding pedagogy, organization, and technological equipment must be addressed. These include accessibility, skills, special needs, new pedagogical approaches, and security and privacy concerns, which impact optimal learning outcomes (Ala-Mutka et al., 2009).

As various benefits and challenges of Web 2.0 tools are identified, psycho-educational programs should take them all into account to carry out adjustable interventions, especially when concerning the sensitive area of ADHD, diversity, team creation, goals, and procedures have to be taken into serious consideration.

Psycho-educational Programs for ADHD Students

Students with ADHD can exhibit antisocial behaviors that make it difficult for teachers to apply cooperative activities. Also, symptoms of ADHD are often coupled with inattention, impulsivity, and overactivity (Lerner & Lerner, 1991).

Behavioral interventions including a psycho-education element could be valuable for improving social skills of ADHD students (Powell et al., 2021). It is suggested that behavior management can be part of a multimodal treatment plan for students with ADHD (Ferguson, 2000). Bandura's social-learning theory applies to students with disabilities and provides a rationale for inclusion (Tadayon Nabavi & Bijandi, 2012). Students with special needs mainstreamed in regular education classrooms are offered an opportunity to observe and learn from role models without disabilities. They need to be exposed to role models who display an interest in academic achievement, appropriate behavior, and motivation (Zambo, 2006).

Moreover, assistive technology can help students with ADHD achieve success by working independently (Stanberry & Raskind, 2022). There are certain gadgets and software that can be of great help to ADHD students such as electronic math worksheet software, talking calculators, portable word processors, speech-recognition programs, and word-prediction software.

A lot of limitations have been traced in previously conducted interventions and programs targeted on ADHD students and their social and cooperative level. In Cerezo et al. (2019) some efforts are made to transfer previous experience with other neurodiverse children in the field of tangible tabletops to ADHD children. The results have led to a set of guidelines which are mostly general and applicable to the design of any interactive application oriented to ADHD children. The study, however, did not take place in a normal classroom and did not involve any interaction with the normal students.

Furthermore, in Bolic et al. (2013) computer use in educational activities by students with ADHD is investigated in comparison with that of students with physical disabilities. The results indicate that students with ADHD report limited computer use in several educational activities in school compared with students with physical disabilities and students without disabilities. However, the study focuses on students aged between 12-18 years and that the psychological prospect in terms of communication and collaboration.

Also, in Aslanides et al. (2016) Project-based Learning (PBL) is discussed as a suggested pedagogical method. The raised issues were in reference to the definition of PBL, its pros and cons, the soft skills that one can develop through it, and the requirements for it to be suitably applied in the University curriculum. The limitations found here are that all participants were well-educated adults, the study was mainly based on discussing the pros and cons of PBL and on questionnaires, and there was no practical application.

Finally, in Navarro et al. (2003) it is examined whether a Computer Assisted Instruction (CAI) approach would be successful in achieving

higher rates of attention. Results suggest that children from the experimental group significantly improved their attention behavior after 10 training sessions with the specific computer software. However, there was no reference to social and cooperative skills.

According to Taylor and Larson's (1998) suggestions, teachers should collaboratively establish team rules and written procedures with students. Key suggestions for implementing teams include promoting diversity appreciation, engaging in team-building activities, maximizing heterogeneity, providing clear objectives and procedures, managing task time effectively, assigning specific roles/tasks, implementing attention-focusing signals, and grading students individually.

The Present Study

Few studies, so far, have focused on the ways of making real use of computer-based projects in order to improve the levels of cooperative and social skills of ADHD students during their cooperation with their non-ADHD classmates. As a result, this study aims to investigate the effectiveness of a socio-educational intervention program using wiki tools to boost the cooperative and social skills of junior high-school students with ADHD and their peers. As a general hypothesis, it is expected that the present intervention will contribute to the development of social and cooperative skills of students with ADHD.

Considering this, this study has the following specific aims:

a) To evaluate differences in cooperative skills (preference for teamwork, preference for individual work, and difficulty adapting to group work) in ADHD students and non-ADHD students before and after carrying out the Pwork wiki tool.

b) To examine differences in social skills (collaborative, empathy, irritability, and causing disturbance) in ADHD students and non-ADHD students before and after carrying out the Pwork wiki tool.

Gathering this study's priorities, goals, and knowledge, we come down to the following hypotheses:

a) It is expected that differences in cooperative skills in ADHD students and non-ADHD students will be found, specifically, an increase in the preference for teamwork, and a decrease of preference for individual work and difficulty adapting to group work after carrying out the Pwork wiki tool.

b) It is expected that differences in social skills in ADHD students and non-ADHD students will be found, specifically, an increase in their collaborative skills and empathy, and a decrease of their irritability and causing disturbance) after carrying out the Pwork wiki tool.

Method

Participants

The sample of this single-group study is made up of 183 non-ADHD students, 93 boys and 90 girls between the ages of 12 and 13 years old ($M_{age} = 12.34$, $SD = 0.48$) and 8 ADHD students of 1st and 2nd class of 1 Junior High School of Heraklion Crete in Greece. The ADHD pupils were 5 boys and 3 girls, also between the ages of 12 and 13 years old ($M_{age} = 12.5$, $SD = 0.53$), with officially diagnosed ADHD. Students' medical files and diagnosis were kept in the school, and full access to them was not allowed for privacy. One of the main characteristics of the current group project is the formation of working teams of 3 to 4 members, in each one of the eight 1st and 2nd grade classrooms of the school, with the definite prerequisite that each classroom involved would include at least 1 ADHD student that would normally be integrated into one of the working teams.

Place and Time of Intervention

Pupil groups in 1st and 2nd grade of Junior High School worked on their project during their Information Technology lesson. The curriculum of this lesson includes the topic of Internet Tools in which Wiki Tools are worked. The intervention occurred once a week to align with the curriculum, using the school's IT lab with 7 students' desktop computers, 1 teacher's desktop computer, and the projector. The intervention lasted from November 2022 to February 2023, totalling 14 weeks with an average of 10 hours per classroom.

Instruments

The School Social Behavior Scale (SSBS) (Merrell, 1993) adapted to Greek language (G-SBSS) by Magotsiou et al. (2007) includes four dimensions: Collaborative Skills (five items; e.g., "I work as a team with my classmates"), Empathy (six items; e.g., "I show interest in the feelings of others"), Irritability (six items; e.g., "I often get annoyed and irritated"), and Causing Disturbance (six items; e.g., "I'm causing disturbance in the classroom"). The items were answered on a five-points Likert scale ranging from 1 = *strongly disagree* to 5 = *strongly agree*. In the original study (Goudas et al., 2009) validity and reliability were satisfactory (cooperative skills, $\alpha = .88$; empathy, $\alpha = .85$; irritability, $\alpha = .92$; causing disturbance, $\alpha = .94$).

The G-SBSS demonstrated high internal consistency across its subscales with Cronbach's alpha values typically ranging from .76 for Cooperative Skills in ADHD students to .79 in non-ADHD students; for Empathy, from .89 in ADHD students to .47 in non-ADHD students; for Irritability from .86 in ADHD students to .55 in non-ADHD students; and for Causing Disturbance from .76 in ADHD students to .70 in non-ADHD students.

The Feelings Toward Group Work Questionnaire (FTGW) (Cantwell & Andrews, 2002) adapted to Greek language (G-FTGW) by Goudas et al. (2009) includes three dimensions: Preference for Teamwork (eight items; e.g., "I like to work in a team because that way we help each other"), Preference for individual work (eight items; e.g., "I prefer to work individually because then I have greater willingness to learn"), and Difficulty adapting to Group Work (six items; e.g., "I often feel uncomfortable being in a group because I'm afraid I won't succeed"). The items were answered on a five-points Likert scale ranging from 1 = *strongly disagree* to 5 = *strongly agree*. In the original study (Goudas et al., 2009) validity and reliability were satisfactory (preference to group work, $\alpha = .87$; preference to individual work, $\alpha = .83$; difficulty of adjustment to group work, $\alpha = .95$).

The G-FTGW demonstrated high internal consistency across its subscales, with Cronbach's alpha values typically ranging from .74 for Preference to Group Work in ADHD students to .66 in non-ADHD students; for Preference to Individual Work from .85 in ADHD students to .60 in non-ADHD students; and for Difficulty of Adjustment to Group Work from .89 in ADHD students to .74 in non-ADHD students.

Both instruments were answered by ADHD students as well as by their non-ADHD peers, before and after the intervention program.

Procedure

A wiki platform was designed with the aim to be distributed to all students of 1st and 2nd class of the Junior High School. This included an organized environment with multimedia resources on which students would be able to work with the target to create a "Welcome in Crete" website for foreign students of their age. The work plan included the following tasks: learning the basic activities of editing a wiki, understanding the purpose of their work and their ultimate goal, creating teams of work (keeping into consideration all the guidelines associated with the creation of effective groups), publishing the name

of their group and their group members', visiting the page with the detailed description of instructions and choosing their task, making use of the web 2.0 tool that was suitable for their task and had already been presented to them, publishing the content they created to a new page in the wiki and reviewing and making comments not only on their work but also on others' work.

The next phase involved the process of meeting the headmaster, Information Technology teacher, students, and their parents. The Ethics Committee's Approval was granted by the University which is associated with the present research activity. According to the Greek legislation about PhD research in school environments, the goals of this intervention were explained to all the subjects involved. Parents' consent was obtained before the intervention via email, offering all necessary information about anonymity and confidentiality. Due to Covid-19 restrictions, parents in person meetings with teachers at school were very restricted.

The present intervention studies the results of the answers of all 183 non-ADHD students about their ADHD classmates as well as the answers of ADHD students about themselves. Each classroom consists of 24 or 25 non-ADHD students who give their answers concerning their ADHD classmate. The children of the class completed the scale twice, before (pre)conducting the program and at the end of it (post). The questionnaire used includes the Greek versions of both FTGW and SSBS scales.

The completion of students' group project lasted for about 12 weeks, allowing them to work for an hour every week during the Information Technology lesson. Before starting their project, all 191 students had to complete the questionnaires online (via Google Forms). Before the completion of the scale, which lasted for about one week, verbal feedback and instructions were given to the children highlighting the importance of their answers being honest, and that they could withdraw the study anytime. The 8 ADHD students were asked to answer the questionnaire about themselves, before and after the intervention, while all 183 non-ADHD students followed the same process but answered about their ADHD classmates.

The implemented program consisted of two phases supervised by both the Information Technology teacher and the researcher. During Phase 0 all the prerequisites for the beginning of the intervention had to be reassured such as parental consent answers, final changes on the wiki platform and the determination of working teams of students. Phase 1 included four subparts: Coming into first contact with the students (2 hours), Forming the working groups and guiding them to upload some basic description details about themselves (2 hours), Working on the assigned project (6 hours), and Presenting and commenting on their outcomes (2 hours).

The 191 ADHD and non-ADHD students carried out the same process after the completion of the project, for about one week again. There was no sample attrition.

Statistical Analyses

The dependent variables were the FTGW dimensions: Preference to Group Work, Preference to Individual Work and Difficulty of Adjustment to Group Work, and the SSBS dimensions: Cooperative skills, Empathy, Irritability and Causing Disturbance. The non-ADHD students answered all questions of the questionnaire they were given before and after the intervention, always having in mind their ADHD classmate, while ADHD students answered for themselves.

Descriptive analyses were performed to obtain the mean value, the standard deviation, and the significance value for each one of dimensions of the FTGW and the SSBS, which were derived from the mean of all questions before and after the intervention. Analysis of variance *t*-test for paired samples (paired samples *t*-test) were carried out to determine whether the change in means between the two data collections (pre- and post- intervention) was statistically significant.

Table 1. Mean, Standard Deviation and Paired *t*-test Values of the Dimensions of G-FTGW before and after the Intervention

	Pre-intervention		Post-intervention		Pre-post intervention paired <i>t</i> -test/Wilcoxon signed-rank test					
	<i>M</i> (<i>SD</i>)		<i>M</i> (<i>SD</i>)		<i>t</i>		<i>Z</i>		<i>p</i>	
	Non-ADHD	ADHD	Non-ADHD	ADHD	Non-ADHD	ADHD	Non-ADHD	ADHD	Non-ADHD	ADHD
Preference to Group Work	2.58 (0.40)	2.28 (0.28)	3.85 (0.43)	3.97 (0.26)	-28.32	-2.54	.000	.011		
Preference to Individual Work	3.52 (0.35)	4.21 (0.45)	2.32 (0.52)	2.40 (0.39)	23.84	-2.52	.000	.012		
Difficulty of Adjustment to Group Work	3.67 (0.46)	4.20 (0.50)	2.33 (0.56)	2.02 (0.28)	23.39	-2.53	.000	.012		

Note. Non-ADHD = non-ADHD students; ADHD = ADHD students.

Table 2. Mean, Standard Deviation and Paired *t*-test values of the Dimensions of G-SBSS before and after the Intervention

	Pre-intervention		Post-intervention		Pre-post intervention paired <i>t</i> -test/Wilcoxon signed-rank test					
	<i>M</i> (<i>SD</i>)		<i>M</i> (<i>SD</i>)		<i>t</i>		<i>Z</i>		<i>p</i>	
	Non-ADHD	ADHD	Non-ADHD	ADHD	Non-ADHD	ADHD	Non-ADHD	ADHD	Non-ADHD	ADHD
Cooperative Skills	2.24 (0.56)	2.25 (0.40)	3.67 (0.57)	3.94 (0.56)	-24.27	-2.53	.000	.012		
Empathy	2.27 (0.38)	2.45 (0.42)	3.72 (0.53)	4.08 (0.49)	-29.04	-2.52	.000	.012		
Irritability	3.72 (0.39)	3.90 (0.44)	2.38 (0.50)	2.65 (0.42)	29.52	-2.38	.000	.017		
Causing Disturbance	3.74 (0.43)	3.57 (0.35)	2.20 (0.67)	2.13 (0.70)	27.23	-2.52	.000	.012		

Note. Non-ADHD = non-ADHD students; ADHD = ADHD students.

Results

Feelings toward Group Work: Differences in pre- and post-Intervention Answers of Non-ADHD Students

The results of the analysis of variance Wilcoxon and *t*-test for paired samples show that most of the variables at three dimensions assessed show statistically significant differences, something that indicates the positive effect of the group work students conducted using the Wiki tool in the differentiation of their feelings toward working in groups.

Firstly, as can be seen in Table 1, there was a statistically significant improvement in the Preference Group Work variable $t(183, 182) = -28.32, p < .00$, with a rise of 1.27 in the mean value after the intervention. The effect size is very large suggested both by Cohen's $d = 4.16$ and the 95% confidence interval (CI) for Cohen's d which is [-1.36, -1.18]. Concerning Preference to Individual Work, a statistically significant reduction was found after the implementation of the program, corresponding with a reduction of 1.2 in the mean value and $t(183, 182) = 23.84, p < .005$. The effect size is very large suggested both by Cohen's $d = 2.7$ and the 95% confidence interval (CI) for Cohen's d which is [1.10, 1.30]. Finally, a statistically significant reduction in the levels of ADHD students' Difficulty of Adjustment to Group Work was found with $t(183, 182) = 23.39, p < .005$, indicating a reduction of 1.34 in the mean value after the intervention. Effect size is very large as suggested both by Cohen's $d = 2.61$ and the 95% confidence interval (CI) for Cohen's d which is [1.23, 1.46].

Differences in Pre and Post Intervention Answers of ADHD Students

Quite as important for this research was to collect the opinions of ADHD students on the effect they believe that such a group project had on their outlook of cooperative and social skills, during their cooperation with the rest of their co-workers. For this reason, after a "fixed" random drawing, in order not to be targeted, the ADHD students had to answer the same scale, but this time concerning themselves.

Table 1 showed a statistically significant improvement for the dimension Preference to Group Work $p(Z < -2.54 \approx .011)$ with a rise of 1.69 in the mean value. The effect size is very large as suggested both by Cohen's $d = 6.25$ and the 95% confidence interval (CI) for Cohen's d which is [-5.682, -1.668]. Concerning the Preference to Individual Work, there was a statistically significant 1.81 reduction

of mean value in ADHD students after the implementation with $p(Z < -2.52 \approx .012)$. Effect size is very large as suggested both by Cohen's $d = 9.4$ and the 95% confidence interval (CI) for Cohen's d which is [2.142, 7.040]. Finally, for the Difficulty of Adjustment to Group Work, a statistically significant 2.18 reduction of mean value was observed with $p(Z < -2.53 \approx .012)$. Effect size is very large as suggested both by Cohen's $d = 7.96$ and the 95% confidence interval (CI) for Cohen's d , which is [1.857, 6.218].

The results of the analysis of variance Wilcoxon and *t*-test for paired samples show that most of the variables at four dimensions assessed show statistically significant differences, which proves the effect of the group work students conducted using the Wiki Tool in the differentiation of their social behavior at school.

Results can be seen in Table 2. A statistically significant improvement was found in the Cooperative Skills of students with a 1.43 increase of mean value and $t(183, 182) = -24.27, p < .005$. Effect size is very large suggested both by Cohen's $d = 2.53$ and the 95% confidence interval (CI) for Cohen's d , which is [-1.32, -1.55]. Concerning Empathy, a statistically significant 1.45 rise of mean value in the level of students' empathy was found with $t(183, 182) = -29.04, p < .005$ after the implementation of the program. Effect size is very large suggested both by Cohen's $d = 3.14$ and the 95% confidence interval (CI) for Cohen's d , which is [-1.55, -1.36]. A statistically significant reduction was found of 1.34 in mean value of the levels of Irritability of ADHD students $t(183, 182) = 29.52, p < .005$ after the program. Effect size is very large suggested both by Cohen's $d = 2.99$ and the 95% confidence interval (CI) for Cohen's d , which is [1.25, 1.43]. Finally, a statistically significant reduction of 1.54 in mean value of the levels of disturbance caused by ADHD students was found after the program with $t(183, 182) = 27.23, p < .005$. Effect size is very large suggested both by Cohen's $d = 2.74$ and the 95% confidence interval (CI) for Cohen's d , which is [1.43, 1.66].

Differences in Pre and Post Intervention Answers of ADHD Students

Results can be seen in Table 2. A statistically significant improvement was found of 1.69 in the mean value in the cooperative skills of students $p(Z < -2.53 \approx .012)$. Effect size is very large as suggested both by Cohen's $d = 4.26$ and the 95% confidence interval (CI) for Cohen's d , which is [-3.854, -0.996]. Also, a statistically significant rise was found of 1.63 in the mean value of the level of Empathy of ADHD students with $p(Z < -2.52 \approx .012)$ after the program. Effect size is very large as suggested both by Cohen's d

= 3.57 and the 95% confidence interval (CI) for Cohen's d , which is [-5.468, -1.592]. A statistically significant reduction of 1.25 in the mean value of the levels of Irritability of ADHD students was found after the program with $p(Z < -2.38 \approx .017)$. Effect size is very large as suggested both by Cohen's $d = 5.25$ and the 95% confidence interval (CI) for Cohen's d , which is [0.583, 2.832]. Finally, a statistically significant reduction of 1.44 in the mean value was found in the levels of Disturbance caused by ADHD students after the program with $p(Z < -2.52 \approx .012)$. Effect size is very large as suggested both by Cohen's $d = 2.6$ and the 95% confidence interval (CI) for Cohen's d , which is [1.124, 4.191].

Discussion

Deficiencies in inhibition and self-regulation have turned out to be important factors in theories concerning ADHD (Barkley, 2003). Fortunately, with the help of ICT, the situation is changing as far as executive functions are concerned (Alexopoulou et al., 2019). Computer programs can help in the design and mapping of the mind and ultimately improve the organization and flow of writing that are necessary for students with ADHD (Gkeka et al., 2018). All in all, it seems that children with ADHD prefer interventions that contain technology to traditional techniques, as they feel more secure in such an environment (Bashiri et al., 2017).

The review of studies on interventions in classroom settings with children with ADHD shows their effectiveness in controlling the main symptoms of the disorder, as well as other problems commonly associated with it, such as disruptive behaviors in the classroom or off-task behaviors (Miranda et al., 2006). Systematic observations of the Physics classes integrated with ICT visualized simulations, attended also by ADHD students, revealed results such as improved time without excessive disruptive actions, captured attention and active commitment in learning process (Domínguez & Menchon, 2019). Also, in the case of ADHD Classroom Kit the children had to perform some activities following the cooperative learning methodology, which provided them with opportunities to practice social skills daily in the classroom (Anhalt et al., 1998). Another approach was based on a peer system, a dyadic peer intervention in which each of the children was paired with a peer according to his or her sociometric preferences and other factors like coincidences in academic or sports interests, which encouraged them to cooperate and develop ties of friendship (Hoza et al., 2003).

Real life application examples, simulations, digital or virtual tour, augmentative devices bring the virtual reality to offer vital experiences (Amutha, 2020). Assistive technology (e.g., augmented reality serious games) has also contributed to the field of supporting students with ADHD (Wu et al., 2013), as facilitators of children's engagement through the creation of motivating environments via innovative treatment methods. For example, ATHYNOS (Avila-Pesantez et al., 2018) combines augmented reality with educational games to create a novel architecture for improving ADHD individuals' cognitive-behavioral patterns. The structure showed significant improvement in managing time, social skills, and concentration. In addition, Prins et al. (2013) created the "Braingame Brian" game to help youngsters with ADHD improve their executive skills. All of the characters in the worlds of the game have a problem, so Brian assists them by doing cognitive activities. The findings associated with the game revealed that children's executive skills and various ADHD symptoms improved considerably.

The main findings of the present study seem quite encouraging and promising in terms of the benefits of using Web 2.0 tools to improve sociability and cooperation among students with and without ADHD. All hypotheses are confirmed as students with ADHD showed improvements in terms of their social interaction and cooperation after the intervention, as well as an increase in their preference for

group work. Although studies such as Stanberry and Raskind (2022) suggest that technology can be a support to help students with ADHD achieve success working independently, the results obtained could suggest a different trend, given that students with ADHD also presented a lower level of difficulty in adapting to group work, which is consistent with previous studies (Becker, 1990) as well as the initial hypotheses.

The results found also support the studies conducted by Powell et al. (2021), since cooperative skills and empathy also increased after the intervention for students with and without ADHD. In addition, not only students with ADHD decreased the levels of irritability and disruptiveness after implementing the cooperative work but also non-ADHD students showed the same effect, demonstrating a good flattery to the work groups with their peers that was perceived. Ultimately, all students found that this intervention has really benefited their cooperation and socialization with each other, improving previous problem behaviors such as impulsivity and discomfort to group learning that had been barriers to their efforts in the past.

However, this study is not exempted of limitations such as restrictions on access to schools resulting from the COVID-19 pandemic, which may have affected the sample size, or the research gap this study faced. Nevertheless, empirical findings demonstrate that the use of educational-related online applications and wiki tools increased during the pandemic (Ponce-Gómez et al., 2023). There has been little research in the field of using Web 2.0 tools, especially Wiki tools, in order to organize a psycho-educational intervention targeting both ADHD and non-ADHD students, including the need to validate the instruments with Greek students. The unbalance between the number of the participating ADHD and non-ADHD students could also be considered as a limitation, although it is a generalized characteristic of all Greek school classrooms. Finally, the absence of control and experimental group, due to the characteristics of intervention to whole classroom populations, could also be considered a limitation.

Conclusions

In this study, all the conclusions are associated with the methods of enhancing the social and cooperative skills of ADHD students by providing them with a well-organized wiki-based group project for them to cooperate with their non-ADHD classmates. Both hypotheses of the current study were confirmed. More specifically, the current intervention has proved that during the group project completed by our sample, ADHD students' preference to group work was increased, while their preference to individual work as well as their difficulty of adjustment to group work was importantly decreased. Same results were found for non-ADHD students. Moreover, ADHD students' cooperative skills and empathy were tremendously enhanced while their levels of irritability and disturbance causing were restrained; results were similar for non-ADHD students. All zero hypothesis that we had initially formed were eventually rejected, as the results of the whole program proved out to be very beneficial for the cooperative and social processes developed between the ADHD and non-ADHD group workers. The former conclusions were extracted not only from the answers of non-ADHD students about the behavior of their ADHD peers, but also from the ones of the ADHD students about their own behavior.

The current intervention makes it clear that by studying and enforcing the correct psycho-educational methods, even to groups of students that seem to lack important social and cooperative skills, there can be important improvements to their performance as collaborators. The present study was inspired from the difficulty of ADHD students to be integrated in peer projects because of the symptoms of impulsivity, hyperactivity, and low concentration from which they often suffer. However, by enforcing the appropriate

techniques and conditions, according to which their work is structured, they can show great advancement in the way they interact with their peers as equally important collaborators. Such could therefore amplify the feelings of self-esteem and worthiness of ADHD students and offer them motivation to improve their social relationships and interactions. Future research should consider analyzing the efficacy of the intervention including an experimental design with a control group. Also, carrying out the intervention in different contexts and countries and even with populations with diverse necessities.

Conflict of Interest

The authors of this article declare no conflict of interest

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Students' Cooperative and Social Skills Using Web 2.0
Tools**

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