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# Enhancing group interactions and story quality in primary school students: an investigation into the impact of collaborative storytelling methodologies

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**Abstract**
This study examines the impact of collaborative storytelling methods on group interactions and story quality in primary school students. Participants (97 students, grades 1–3) engaged in tangible digital collaborative storytelling (TDST), collaborative digital storytelling (DST), and traditional storytelling (TST). The research explored three hypotheses: (1) TDST promotes more inclusive and prosocial interactions than DST, (2) collaborative stories show higher formal and content quality than individual stories, and (3) collaboration parameters influence story quality across methodologies. Employing a cross-sectional design, the findings demonstrated significant differences in group interactions and story characteristics In our study, students engaged in tangible digital collaborative storytelling (TDST) demonstrated reduced interruptions and enhanced task focus compared to traditional methods. Collaborative stories, particularly in TDST, were concise, with fewer off-task elements and higher narrative cohesion than individual stories. Notably, a significant correlation between story cohesion and inclusive space was observed. These findings highlight the significance of integrating tangible digital tools, providing valuable insights into enhancing collaborative storytelling for positive group dynamics and improved story quality among young students. This research holds implications for educational environments and therapeutic interventions, emphasizing the role of collaborative storytelling in fostering communication and group cohesion.

**Keywords** Collaborative Storytelling · Primary Education · Incusive Education · Digital Learning Tools

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## Introduction

Collaborative storytelling represents a useful methodology to promote the development of cognitive and social skills in school context. Students have the possibility to share events, representations, memories, beliefs, and images while interacting with the social context (Botvin & Sutton-Smith, 1977; Bruner, 1991; Iandolo et al., 2012, 2020). Narrative competence is generally developed during early childhood (Esposito et al., 2020; Iandolo et al., 2012) and it represents a fundamental social skill to build knowledge by sharing ideas and experiences (Iandolo et al., 2012; Iandolo, 2021; Ohler, 2008; Robin, 2008; Wood & O'Malley, 1996). Children, in fact, tell stories to know themselves and to know reality: for this reason, storytelling has been used to work on emotional and psychological content because it favors social cognition, empathy and active listening (Banks, 2012; Donovan, 2018) and contributes to develop communicative and emotional skills (Banks, 2012). Furthermore, storytelling promotes the ability to negotiate and convey messages effectively (Iandolo et al., 2012, 2020; Robin, 2008; Wood & O'Malley, 1996).

Due to its numerous benefits for learning, classroom collaboration has become a popular research topic, promoting and enhancing students' learning, social abilities, and inclusivity. Collaborative learning has been shown to be an effective methodology for promoting inclusion within the school environment (Johnson & Johnson, 1989; Laal & Ghodsi, 2012; Stanton et al., 2001). In pursuit of enhancing this collaborative experience, technology plays a pivotal role (Cattoni et al., 2024). Tangible interfaces, for instance, can foster social learning by providing access to a shared representation of problems, thereby reducing cognitive load and encouraging interaction. Research demonstrates that such interfaces can slow down interaction and increase the effort required, thus fostering more discussion and collaboration among children (Chandrasekera & Yoon, 2015). For example, Stanton et al. (2001) developed a tangible user interface for collaborative storytelling, where children gathered around a vertical screen to navigate story drawings on a "magic carpet," enhancing visibility and the openness of interaction, as similarly observed with Tangible Multi-Touch Tabletops (Leversund et al., 2014).

### Digital storytelling (DST)

In contemporary educational settings, digital storytelling (DST) has emerged as an inclusive methodology that integrates traditional storytelling (TST) with multimedia technology. DST represents the fusion of traditional narrative forms with the use of multimedia elements, such as images, sounds, and words, to create engaging and interactive narratives (Heo, 2009; Lowenthal & Dunlap, 2010; Normann, 2011). It serves as a valuable tool for enhancing students' narrative skills and fostering collaboration (Baumer et al., 2005; Di Fuccio & Mastroberti, 2018; Iandolo, 2011; Nicolopoulou et al., 2015; Zancanaro et al., 2007).

Traditional storytelling involves the oral or written recounting of stories to an audience, either individually or in small groups. TST provides a foundation for

collaborative story creation, where participants contribute to the narrative construction process, leading to the development of cohesive and engaging stories.

Digital storytelling tools offer unique opportunities for students to integrate multimedia elements into their narratives, allowing for a multisensory storytelling experience that can be enjoyed individually or in groups. Research has demonstrated the significant benefits of digital tools in facilitating knowledge acquisition, idea generation, and collaborative learning (Standley, 2003).

Moreover, digital storytelling enhances narrative, linguistic-expressive, and social skills, as students engage with interactive media to communicate their ideas effectively (Robin, 2008). Collaborative digital storytelling experiences promote cooperation, decision-making, and effective communication, essential skills for conveying messages to diverse audiences.

In educational contexts, the use of digital storytelling supports various learning outcomes, including reflective learning, creativity, and technological proficiency (Barrett, 2006; Di Blas, 2009, 2010; Ohler, 2008; Catale et al. 2017). It fosters cognitive processes such as information-gathering, content comprehension, vocabulary expansion, and writing skill development (Burmark, 2004; Kajder & Swenson, 2004; Papadopoulou & Ioannis, 2010).

Furthermore, DST has been instrumental in promoting the inclusion of students with special needs by providing opportunities for active participation and contribution in collaborative storytelling activities (Barrett, 2006; Porter, 2004). By engaging in collaborative story creation, students with diverse abilities can contribute their unique perspectives, fostering positive interdependence and active listening among group members (Banks, 2012; Faver & Alanis, 2012).

### Tangible digital storytelling (TDST)

Tangible Digital Storytelling applications (TDST) are innovative educational devices that are yet to be fully explored within the school context (Iandolo et al., 2020; Sweeney-Burt, 2014). These devices combine tangible and multisensory elements with traditional storytelling tools, drawings, audio recordings, movements, and dramatization (Eisenberg et al., 2004; Resnick et al., 1998). For instance, the devices can incorporate a touch screen feature, enhancing fine and gross motor skills through tactile interactions. Students can also scan their drawings or small objects, effectively bridging the gap between physical and digital realms. Furthermore, the inclusion of voice recording capabilities enables students to engage their auditory senses by attributing voices to characters. This seamless integration facilitates a smooth transition between TST and the creation of digital storyboards, offering students a comprehensive, multidimensional experience. Moreover, the multisensory dimension of TDST promotes the students' engagement and enhances their learning experience (Eisenberg et al., 2004). The combination of tangible and digital stimuli also aims to promote opportunities for students' collaboration: interaction with digital learning environments (Iandolo et al., 2020; Resnick et al., 1998) facilitates the use of TDSTs in pre-school and primary school as well as the applications with specific

learning needs (Giovannella, 2014; Iandolo et al., 2020). TDST links digital and traditional storytelling educational experiences such as face-to-face collaboration, tangible, and digital learning environments (Harley et al., 2016; Stanton et al., 2001). In addition, the existing body of research on tangible devices also proposes that they can foster students' interest and motivation (Mateu et al., 2013) since a playful learning environment can be created with physical objects interacting with virtual environments creating captivating learning environments (Baranauskas and Posada, 2017).

Few studies have specifically explored the benefits of storytelling tools like TDST in early educational stages (Sweeney-Burt, 2014; Zancanaro et al., 2007) compared to the existing literature on digital storytelling in adulthood and higher educational levels (Banaszewski, 2005; Ohler, 2008). However, the combination of digital and tangible tools offers an opportunity to extend the potential of tangible digital storytelling to kindergarten and primary school students (Baumer et al., 2005; Di Fuccio & Mastroberti, 2018; Iandolo, 2011; Zancanaro et al., 2007).

The multidimensionality of TDST promotes inclusion: it promotes the development of collaborative and social skills both in typically developing (Garcia-Sanjuan et al., 2018; Schneider et al., 2010) and Special Education Needs (SEN) children (Al Mahmud & Soysa, 2020; Alessandrini et al., 2016; Hourcade et al., 2012). In addition, TDST, unlike DST, allows combining different dimensions and can be considered a "phygital" product, encompassing both physical and digital realities (Goretti et al. 2020).

TDST can stimulate teachers to plan and implement educational activities to engage students with different functioning and with neurodiversity. This inclusive approach also promotes individualization and personalization in the school context (Baldacci, 2005; Cottini, 2017; Ianes & Canevaro, 2015; Ianes & Tortello, 1999).

## Study aims

The study aimed to investigate three hypotheses related to using different collaborative storytelling methodologies and their impact on group interactions, stories' formal and content quality, and the relationship between collaboration parameters and story quality. The specific research questions were as follows:

**H1** Collaborative stories (DST and TDST) would show higher formal quality and richer content than individual stories.

**H2** Higher collaboration parameters' scores would be linked to improved story quality, highlighting the significance of collaborative processes in storytelling, irrespective of the methodology used.

**H3** TDST would promote more inclusive and prosocial group interactions compared to DST.

### Rationale

H1. This hypothesis aimed to assess differences among TST, collaborative stories facilitated by digital and tangible digital methodologies (DST and TDST), and individual stories concerning their formal aspects and content quality. Individual stories were obtained through oral recounting by each child following solitary play with the characters from the Bears Family projective test (e.g., freely choosing whether to move the puppets), which were then transcribed by the researcher. It is hypothesized that collaborative stories will demonstrate superior quality in both formal aspects and content compared to individual stories. This anticipation is grounded in the principles of social constructivism, positing that collaborative processes foster the co-construction of knowledge, leading to narratives with enhanced depth and complexity (Bruner, 1990; Vygotsky, 1978). It is expected that collaborative storytelling will result in richer content and higher formal quality, attributed to the collective contributions of group members (O'Connor & Michaels, 1993; Stahl, 2006). The collaborative nature of storytelling is anticipated to offer participants meaningful learning experiences, facilitating the exploration of diverse perspectives and the development of comprehensive narratives (Mercer, 2000; Mercer & Littleton, 2007; Slavin, 1995).

H2. This hypothesis explored the relationship between collaboration parameters and story quality, emphasizing the significance of collaborative processes in storytelling, irrespective of the methodology. The expectation was that higher levels of collaboration would be linked to enhanced story quality. Collaboration parameters comprise 10 dimensions subject to investigation and observation, including Interruptions, Group self-regulation, Positive comments regarding contributions, and Focus on the task. Additionally, these parameters encompass six categories focusing on collaboration parameters and prosocial behaviors: social awareness, social cognition, social communication, social motivation, inclusive communication, and inclusion. It is hypothesized that collaboration serves as a significant factor positively influencing the quality of stories, regardless of the type of tool used for their co-construction (Smeda et al., 2014).

H3. The hypothesis comparing the effects of collaborative TDST and DST on group interactions was based on the understanding that different forms of representation engage various learning styles. It was hypothesized that TDST, with its multisensory dimensions aligning with the principles of Universal Design for Learning (CAST, 2018), would foster more inclusive and prosocial group interactions compared to DST. The tactile and interactive nature of TDST was anticipated to provide a richer learning experience, catering to diverse sensory needs and enhancing social engagement among participants (Edyburn, 2010; Rose, 1999).

By investigating these research hypotheses, the study sought to provide insights into the potential benefits of different collaborative storytelling approaches and their implications for group interactions, story quality, and the promotion of inclusive and prosocial learning environments. In this study, we explore two primary facets of storytelling in educational settings: the comparative efficacy of individual versus collaborative storytelling, and the impact of different storytelling technologies—Tangible Digital Storytelling (TDST) and Digital Storytelling (DST). Our hypotheses are

structured to address these dimensions comprehensively. Hypotheses 1 and 2 delve into the nuances of storytelling performance and interaction patterns between individual and collaborative settings, aiming to elucidate why collaborative approaches might be more effective. Hypothesis 3 compares TDST and DST within collaborative contexts to assess how different technological interfaces can further enhance the storytelling experience and learning outcomes. The pedagogical value of collaboration, supported by tangible interfaces, is highlighted as a means to reduce cognitive load and foster more meaningful interactions, as evidenced by research on tangible user interfaces for collaborative storytelling. By integrating these approaches, our study aims to provide a holistic understanding of how individual and group dynamics, supported by appropriate technological tools, contribute to learning through storytelling.

## Method

### Participants

A total of ninety-seven students ($n = 97$) participated in the study, comprising 56 boys (57.73%) and 41 girls (42.27%). These students were enrolled in 1st to 3rd grade, with two classes per grade, at a primary school in the north of Italy. The distribution of participants across the grades was as follows: 1st grade ($n = 31$), 2nd grade ($n = 30$), and 3rd grade ($n = 36$). The age range of the students was between 6 and 8.5 years, with a mean age of 7 years and a standard deviation of 10.26 months (Table 1). Among the participants, 80 students (82.47%) exhibited typical development, while 17 (17.53%) faced specific difficulties. These difficulties included neurodevelopmental disorders in 13 students (13.40%), functional emotional or behavioral difficulties in 1 student (1.03%), and a combination of both neurodevelopmental and functional comorbid difficulties in 4 students (4.12%). It is worth noting that students with difficulties were distributed across different grades, ranging from a minimum of 4 students in 1st grade to a maximum of 8 students in 3rd grade. Additionally, each class had at least one student facing difficulties.

Including students with diverse developmental profiles provided an opportunity to explore the impact of different collaborative storytelling methodologies on both typically developing students and those with specific challenges. This diverse sample enhances the ecological validity of the study and allows for a more comprehensive understanding of the findings within an educational context.

To be noted, the University of Trento ethics committee approved the research protocol and, thus, the entire research was carried out in accordance with the principles of the Declaration of Helsinki.

Based on the baseline results presented in Table 2, it can be observed that the group mean scores for both the WISC-IV Matrix Reasoning task (Wechsler, 1949) and the NEPSY-II verbal fluency test (Korkman et al., 2007) fall within the expected norms for fluid intelligence and verbal fluency skills, respectively. Specifically, the mean score for the WISC-IV Matrix Reasoning task is 11.57 with a standard deviation of 4.44. For the NEPSY-II verbal fluency test, the mean scores are as follows:

**Table 1** Participants

| | N | Age in months | | | Gender | | Students | | Difficulty type | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Min (Max) | M | SD | Female | Male | No difficulty | With difficulty | Neurod. ① | Funct. ② | Neurod. & Funct |
| 1st grade | 31 | 72.00 (84.00) | 72.39 | 2.16 | 16 (51.61%) | 15 (48.39%) | 27 (87.10%) | 4 (12.90%) | 4 (12.90%) | 0 (0.00%) | 0 (0.00%) |
| 2nd grade | 30 | 84.00 (96.00) | 85.20 | 3.66 | 10 (33.3%) | 20.00 (66.67%) | 25.00 (83.33%) | 5 (16.66%) | 4 (13.33%) | 0 (0.00%) | 1 (3.33%) |
| 3rd grade | 36 | 84.00 (108.00) | 96.00 | 2.88 | 15 (41.67%) | 21.00 (58.33%) | 28.00 (77.78%) | 8 (22.22%) | 5 (13.89%) | 1 (2.77%) | 2 (5.56%) |
| Total | 97 | 72.00 (108.00) | 85.11 | 10.26 | 41 (42.27%) | 56.00 (57.73%) | 80.00 (82.47%) | 17 (17.53%) | 13 (13.40%) | 1 (1.03%) | 3 (3.09%) |

Descriptive statistics and frequencies ($n = 97$)

**Table 2** Baseline verbal fluency and matrix reasoning scores ($n=97$)

| | | $n$ | NEPSY-II Verbal Fluency Scores (Mean 10; SD 3) Semantic fluency | | | | NEPSY-II Verbal Fluency Scores (Mean 10; SD 3) Phonological fluency | | | | WISC-IV Matrix Reasoning (Mean 10; SD 3) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Min | Max | M | SD | Min | Max | M | SD | Min | Max | M | SD |
| Class 1 | Group 1 | 16 | 1.00 | 15.00 | 7.00 | 3.97 | 2.00 | 17.00 | 8.80 | 4.13 | 3.00 | 11.00 | 8.79 | 2.58 |
| | Group 2 | 13 | 1.00 | 13.00 | 8.54 | 3.48 | 5.00 | 13.00 | 9.08 | 3.60 | 2.00 | 17.00 | 12.46 | 4.56 |
| | Group 3 | 18 | 6.00 | 19.00 | 11.72 | 3.83 | 5.00 | 19.00 | 9.67 | 3.60 | 1.00 | 17.00 | 13.50 | 4,11 |
| | Subtotal Class 1 | 47 | 1.00 | 19.00 | 9.08 | 3.76 | 2.00 | 19.00 | 9.18 | 3.29 | 1.00 | 17.00 | 11.58 | 3.75 |
| Class 2 | Group 1 | 15 | 3.00 | 13.00 | 7.53 | 3.38 | 3.00 | 15.00 | 8.13 | 3.56 | 1.00 | 12.00 | 7.87 | 3.58 |
| | Group 2 | 17 | 5.00 | 16.00 | 8.29 | 3.12 | 5.00 | 14.00 | 9.00 | 2.54 | 1.00 | 17.00 | 12.00 | 5.25 |
| | Group 3 | 18 | 2.00 | 9.00 | 5.59 | 2.45 | 4.00 | 13.00 | 7.24 | 2.49 | 9.00 | 18.00 | 13.89 | 2.70 |
| | Subtotal Class 2 | 50 | 2.00 | 16.00 | 7.14 | 2.98 | 3.00 | 15.00 | 8.12 | 2.86 | 1.00 | 18.00 | 11.25 | 3.84 |
| Total | | 97 | 2.00 | 19.00 | 8.64 | 3.21 | 1.00 | 19.00 | 8.18 | 3.87 | 1.00 | 18.00 | 11.57 | 4.44 |

Semantic Fluency: 8.64 (SD 3.21) and Phonological Fluency: 8.18 (SD 3.87) (Table 2). It is important to note, however, that there are some students who scored below the mean values, as indicated by the minimum values shown in Table 2.

## Design

The study employed an experimental, mixed, and cross-sectional design to investigate the effects of different collaborative storytelling methodologies on storytelling, inclusion, and interaction.

The experimental structure of the study involved five research phases, as depicted in Fig. 1.

[1] First Assessment: First, an individual baseline assessment was conducted to evaluate participants' non verbal reasoning competence using the Matrix reasoning task of the Wechsler Intelligence Scale (WISC-IV, Wechsler, 1949), narrative skills using the Bears Family Projective test (Venuti & Iandolo, 2003; Iandolo et al., 2012)

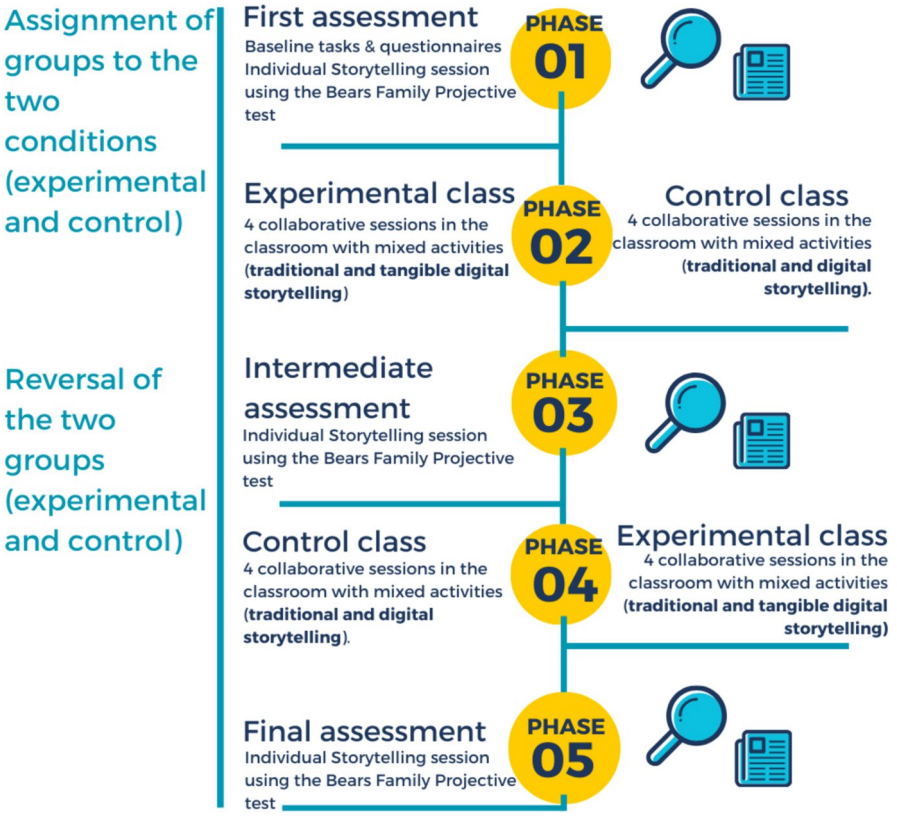


**Fig. 1** Flowchart of the study. Created with Canva (https://www.canva.com/)

and verbal fluency using the NEPSY-II test (Korkman et al., 2007). Next, the classes were assigned to either the experimental or control condition.

[2] Initial Individual Storytelling (iTST): We individually assessed each participant's narrative skills using the Bears Family Projective Test (Venuti & Iandolo, 2003; Iandolo et al., 2012). This assessment was conducted in a controlled setting that mimics a traditional storytelling environment, where each participant individually narrated a story using puppets. The individual storytelling sessions were conducted before the start of group activities, during the intermediate phase (after 4 days of collaborative TST and TDST activities), and in the final phase (after another 4 days of TST and DST activities), for both the experimental and control class groups. This baseline individual TST session ensured baseline narrative abilities were captured before group dynamics influenced outcomes.

[3] Collaborative Storytelling Sessions: Following the assignment, collaborative storytelling sessions were conducted. The experimental condition classes participated in four collaborative storytelling sessions using both the cTST and TDST. The control condition classes engaged in four collaborative storytelling sessions using the cTST and DST.

[4] Intermediate Individual Storytelling (iTST): After the initial set of sessions, an intermediate individual Storytelling session (iTST) using the Bears Family Projective test (Venuti & Iandolo, 2003; Iandolo et al., 2012) was conducted with each participant, where each participant individually narrated a story using puppets. This session was designed to assess each participant's narrative skills in a traditional storytelling format, isolated from group influences.

[5] Group Reversal: The experimental and control groups swapped their previous storytelling methodologies to assess the adaptability and influence of different storytelling techniques.

[6] Continued Collaborative Storytelling: Further storytelling sessions followed the group reversal, with the same formats as before the switch.

[7] Final Individual Storytelling (iTST): A concluding session using the Bears Family Projective Test assessed any changes in the participants' narrative skills post-intervention.

Throughout the study, researchers and teachers worked with eight primary education classes. Each class was divided into four collaborative groups. Each class accomplished eight collaborative storytelling sessions, four in the experimental condition (cTST & TDST) and four in the control condition (cTST & DST), throughout November 2021 and February 2022. For a more comprehensive description of the group composition, collaborative stories, and the methodologies used in the different conditions, we direct the reader to Supplementary Table 1. Further, a comparison of story variables and collaboration parameters regarding cTST during experimental and control conditions can be found in Supplementary Table 2. While descriptive statistics of story analysis and collaborative parameters can be found in Supplementary Table 3 and 4 respectively.

As a result, collaborative groups created a total of 192 collaborative stories (one story per group and session) divided into 144 stories with traditional methodology (75% cTST), 24 stories with digital methodology (12.50% DST), and 24 stories with tangible digital methodology (12.50% TDST).

## Instruments

### Assessment

For individual data collection, we employed five individually administered instruments: two cognitive measures, the Matrix Reasoning subtest of the Wechsler Intelligence Scale (WISC-IV, Wechsler, 1949), the NEPSY-II verbal fluency test (Korkman et al.,, 2007), and a projective instrument: the Bears Family Projective Test (Bornstein & Tamis-LeMonda, 1995; Iandolo, 2011; Venuti & Iandolo, 2003). two ad-hoc questionnaires, one for teachers and one for parents.

- The Wechsler Intelligence Scale for Children (Wechsler & Kodama 1949) is a clinical instrument designed to evaluate the intelligence quotient (Mean = 100, sd = 15) in children and adolescents aged between 6 and 16 years and 11 months, considering four main areas: Verbal comprehension, Perceptual Reasoning, Working Memory and Processing Speed. For the purpose of this study, the Matrix Reasoning subtest was used. It assesses visuospatial competence and spatial perception, and it is indicative of fluid intelligence, particularly inductive and sequential reasoning. The subtest requires participants to individuate the correct piece that completes an incomplete matrix, choosing between different options. The performance receives a score between 1 and 19 (mean = 7, sd = 3).
- The NEPSY-II is a neuropsychological battery (Korkman et al., 2007) that can be administered to children aged between 3 and 16 years and 11 months, it is composed by 33 subtests which evaluate 6 different domains (Attention and Executive Functions, Language, Memory and Learning, sensorimotor functions, social perception and visuospatial elaboration). For this research purposes the verbal fluency subtest was considered. Verbal fluency is composed of two parts, phonological and semantic fluency, and requires participants to name words based on a phonetic cue for the first part or a semantic category for the second one. This sub test evaluates language skills, vocabulary acquisition, and retrieval.
- The Bears Family Projective Test is a thematic constructive-projective test that stimulates and assesses storytelling in children aged 3 to 11 years (Bornstein & Tamis-LeMonda, 1995; Iandolo, 2011; Venuti & Iandolo, 2003). During the test, children play and are requested to individually create a story using the Bears Family playset composed of eight characters (father, mother and two children bears, a doctor, a policeman, a goose and a rabbit) and environment pieces: kitchen, living room and playground. The story is videotaped, transcribed verbatim, and analyzed using the Bears Family Integrated Story Analysis System to explore story features (e.g. narrative production) and relational dynamics between characters.
- The teacher questionnaire collects customized information about the student, including familiarity with the student, the teacher's knowledge of the student's skills, and any difficulties or disorders the student may have. The parental questionnaire also collects information about the student, including personal

data, family composition, parental education and occupation, child behavior, strengths, and difficulties.

For group data collection, two instruments were used based on video recordings of the sessions: the Bears Family Integrated Analysis System for story analysis (Alonso-Campuzano et al., 2021; Iandolo, 2011; Iandolo & Alonso-Campuzano, 2021; Venuti & Iandolo, 2003) and an ad-hoc observation sheet for collaborative stories.

The students created three individual stories by initially playing with the characters of the Bear Family and then orally inventing a story (choosing freely whether to move the puppets). Please note that the experimenter then transcribed the stories. For the individual stories, the students were given 5 min (with some flexibility to respect each student's pace). The individual stories were invented every two weeks. The storytelling activities took place during Italian language classes to promote the consolidation of narrative skills.

The stimuli used for the storytelling activities varied; however, core themes such as friendship, conflict, help, and bullying were consistently employed across both collaborative and individual activities. Although individual activities relied on stimuli provided by puppets and objects, both individual and group stories were assessed using the same parameters established within the 'Bear Family Test.' This approach ensures that both tools, despite using different sensory stimuli, elicit narratives centered around the same thematic cores—friendship, conflict, help, and bullying.

The collaborative stories were created in small groups: a different theme-based iconic stimulus was presented for each meeting. Themes included friendship, conflict, bullying, and help. The classroom teacher conducted the activities which were divided into different phases: stimulus presentation, group discussion, story creation, and final presentation; meanwhile, the researcher noted down group dynamics by filling out observational sheets. The activity had a total duration of 90 min. The stories were evaluated with the instrument created for the study, assessing various aspects of participants' collaboration during storytelling activities using different methodologies (cTST, DST, and TDST). The sheet included ratings from observers (researcher and teacher) on four categories related to handling the task and managing group dynamics: Interruptions, Group self-regulation, Positive comments regarding contributions and Focus on the task. Additionally, it included six categories focusing on collaboration parameters and prosocial behaviors: social awareness, social cognition, social communication, social motivation, inclusive communication and inclusion. A group interruptions, off-task conversations, self-regulation, positive comments, focus on the task, social awareness, cognition, communication, motivation, space for everyone during task interactions, and inclusion. A three-point Likert scale (1 No/Never; 2 Enough/Sometimes; 3 A lot/Always) was used to evaluate the different areas.

**Description of variables**

**Category 1**: Group Management

- Interruptions: This variable measures how often interruptions occur when a group member is speaking. It can indicate the level of respect and active listening within the group.
- Self-regulation: This variable assesses the group members' ability to manage their own behavior and emotional responses to situations that arise within the group. It reflects emotional intelligence and self-control.
- Positive comments: This variable quantifies the frequency of compliments and positive feedback given by group members regarding the ideas or contributions of others. It can indicate the level of support and encouragement within the group.
- Focus on task: This variable measures the group's level of attention and concentration on the assigned task or the topic under discussion. It reflects the group's ability to stay on track and avoid distractions.

**Category 2**: Collaboration parameters

- Social awareness: this variable evaluates each group member's consideration of the perspectives and feelings of others. It reflects empathy and the ability to understand the viewpoints of fellow group members.
- Social cognition: This variable examines how group members process information related to the social dynamics of the group. It may include their understanding of group roles, power dynamics, and interpersonal relationships.
- Social communication: Social communication assesses how group members use both verbal and non-verbal language to express their thoughts and emotions within the group. Effective communication is essential for successful collaboration.
- Social motivation: This variable gauges each student's desire and motivation to actively participate within the group. It reflects their willingness to engage in group activities and discussions.
- Inclusive communication: Inclusive communication evaluates each group member's ability to create an environment that is supportive and fosters effective communication. It involves making all group members feel valued and heard.
- Inclusion: Inclusion measures the extent to which all group members, regardless of their cognitive functioning or differences, actively participate within the group. It reflects the group's commitment to diversity and inclusion.

Individual and collaborative stories obtained during the study-phase were transcribed verbatim and subsequently analyzed using the Bears Family Integrated Story Analysis System (Iandolo, 2011; Iandolo & Alonso-Campuzano, 2021). The system evaluates stories across three key areas of formal analysis:

- Microstructure: this area pertains to story length and is based on factors such as the number of words, propositions, and story episodes.
- Narrative Structure: this area focuses on the presence of typical story structure elements, including the introduction, main character, time/space setting, conclusion, and long-term conclusion.

- Story Cohesion: this encompasses twelve levels, ranging from 0 to 11, which consider the sophistication and elaborateness of the story concerning a problem. The levels range from 0 (No story) to 11.

In terms of story content, the system offers four indexes for comparison:

- Problems with Positive vs. Negative Solutions (Balance 1).
- Solved vs. Unsolved Problems (Balance 2).
- Character's Positive vs. Negative Relationships (Balance 3).
- Adaptive vs. Maladaptive Behaviors (Balance 4).

### Training

We utilized three collaborative instruments for the group activities. A standard protocol was defined and used to structure all collaborative storytelling activity sessions regardless of the methodology used (cTST, DST, TDST).

cTST involved equipping the small group with paper and pencil, allowing them to draw or write the elements of their story while engaging in discussions.

DST involved providing the small group with an Apple iPad Pro 12.9" (2017) with Google Toontastic 3D software. Toontastic 3D enables the creation of animated short films with various story structures, characters, settings, dialogue recording, and music effects. It employs scaffolding principles to support learners in creating digital stories. Several studies have supported the use of Toontastic as a high-quality digital storytelling tool in educational settings (e.g., Lagergen & Holmberg 2017; Nair & Md Yunus, 2022; Pritchard et al., 2019; Russell, 2010).

TDST involved providing the small group with i-Theatre (Iandolo, 2021; Filosofi et al., 2021), a digital and tangible interactive tool designed for creating multimedia stories for children aged four to ten. The i-Theatre combines tangible materials and interactive multi-touch digital technology, offering visual, auditory, and tangible feedback through concrete objects such as a scanner for drawings, personal files, function cards, and recording boxes. It comprises a mobile wooden table with integrated tactile features and a scanner, enabling the composition of digital stories from children's drawings on paper. Once the drawings are scanned into the system, children can manipulate, animate, and rearrange them into sequences, adding words and sounds. Collaboratively, children can record their stories by manipulating characters on the screen and narrating the story using their voices, intonations, and gestures (Fig. 2).

### Statistical analysis

Statistical analyses were performed using R studio (R Core Team, 2020). Normality of the data was assessed using the Shapiro test, while homogeneity of variances was examined using the Levene test.

To test hypothesis one, Wilcoxon rank sum tests were employed to study differences between collaborative and individual stories, independently from the


**Fig. 2** Tools used for Training in Tangible Digital and Digital Storytelling. On the left side, i-Theatre serves as a Tangible Digital Storytelling (TDST) tool, featuring an integrated multi-touch screen and a scanner-drawer. On the right side, Toontastic, a software application used for Digital Storytelling (DST). Toontastic offers a user-friendly interface and a wide range of features to facilitate the creation of engaging digital stories. Created with Microsoft PowerPoint (https://www.microsoft.com/it-it/microsoft-365/powerpoint)

methodology used. Additionally, effect sizes were calculated to provide further insights.

To examine the second hypothesis, Spearman's Rho correlation coefficients were computed to explore the relationships between the story parameters and collaboration parameters.

Lastly, in order to test the third hypothesis, we employed the non-parametric Kruskal-Wallis test to assess median differences between cTST, and DST and TDST methodologies. In the cases where significant differences were detected, post hoc non-parametric tests, specifically Dunn's Multiple Comparison Tests, were conducted.

## Results

Hypothesis 1. Differences between collaborative and individual stories

To investigate the differences between collaborative and individual stories, we examined both stories' formal aspects and content quality. Please refer to Table 3 for a detailed overview of the results. The table presents the variables related to the number of propositions, the presence of off-topic propositions, the number of episodes, and the linguistic connections between sentences within individual and collaborative stories. Regarding formal aspects, we observed that individual stories were longer than collaborative, with a significantly higher number of propositions ($W = 37534$, $p < 0.001$, $r = 0.368$), and off-task propositions ($W = 27789$, $p = 0.04$,

**Table 3** Means, standard deviations and Wilcoxon rank sum tests statistics for Individual and collaborative stories

| Variable | Methodology | *M* | SD | *W* | *p* | Wilcoxon Effect Size |
|---|---|---|---|---|---|---|
| Propositions | Individual | 27.20 | 21.60 | 37,534 | 0.001*** | 0.37 |
| | Collaborative | 14.00 | 10.20 | | | |
| Propositions off task | Individual | 0.23 | 0.72 | 27,789 | 0.04* | 0.10 |
| | Collaborative | 0.16 | 0.68 | | | |
| Episodes | Individual | 12.20 | 7.77 | 37,534 | < 0.001*** | 0.48 |
| | Collaborative | 6.27 | 2.45 | | | |
| Narrative Cohesion | Individual | 7.10 | 2.54 | 21,078 | < 0.001*** | 0.17 |
| | Collaborative | 8.05 | 1.56 | | | |

$p < 0.05$; ** $p < 0.01$, ***$p < 0.001$

$r = 0.095$). and story episodes ($W = 37534$, $p < 0.001$, $r = 0.483$). Regarding narrative cohesion, we found significant differences, indicating higher levels of cohesion in the collaborative stories ($W = 21078$, $p < 0.001$, $r = 0.17$).

Finally, in relation to story content, the results do not indicate significant differences in the content of individual and collaborative stories. These findings indicate that there are distinct differences between collaborative and individual stories in terms of formal aspects. Individual stories tend to be longer, with a higher number of propositions and episodes, while collaborative stories exhibit greater narrative cohesion.

Hypothesis 2. Collaboration parameters and group story features

To explore the relationship between collaboration parameters and story features, regardless of the methodology used, we conducted correlation analyses. Correlation coefficients below 0.20 were considered negligible. Please refer to Table 4 which delineates the correlations between collaboration parameters and various characteristics of the collaborative stories generated. These include the number of propositions and episodes, linguistic connections between sentences, the equilibrium between problems with positive and negative solutions, and the interplay of maladaptive and adaptive behaviors exhibited by characters.

We identified significant, albeit weak, correlations between the number of propositions and all the collaboration parameters. Additionally, the number of episodes showed weak correlations with group self-regulation ($r = 0.22$, $p = 0.002$), focus on the task ($r = 0.22$, $p = 0.002$), and social cognition ($r = 0.20$, $p = 0.006$). Furthermore, we observed a strong correlation between story cohesion and space for everyone ($r = 0.60$, $p = 0.04$).

Concerning story content, the balance index considering story problems' positive and negative solutions exhibited a robust correlation with space for everyone ($r = 0.98$, $p = 0.002$) and weak correlations between the balance index related to story characters' adaptive and maladaptive behaviors and students' focus on the task ($r = 0.21$, $p = 0.004$), social communication ($r = 0.27$, $p < 0.001$), and space for everyone ($r = 0.22$, $p = 0.002$) during collaborative storytelling sessions.

**Table 4** Spearman correlations between collaboration parameters and story variables

| | | Story features | | | | |
|---|---|---|---|---|---|---|
| | | Propositions | Episodes | Cohesion | Balance positive vs negative solutions | Balance adaptive vs maladaptive behaviors |
| Collaboration parameters | Group self-regulation | 0.22** | 0.22** | −0.04 | −0.06 | 0.04 |
| | Positive comments | 0.26*** | 0.11 | −0.05 | −0.04 | 0.02 |
| | Focus on the task | 0.23** | 0.22** | 0.05 | 0.03 | 0.21** |
| | Social awareness | 0.22** | 0.16* | −0.02 | 0.07 | 0.14 |
| | Social cognition | 0.20** | 0.20** | 0.08 | 0.13 | 0.16* |
| | Social communication | 0.20** | 0.14 | 0.14 | 0.16* | 0.27*** |
| | Social motivation | 0.21** | 0.15* | −0.08 | 0.06 | 0.15* |
| | Space for everyone | 0.26*** | 0.11 | 0.60* | 0.98** | 0.22** |
| | Inclusion | 0.27*** | 0.10 | 0.01 | 0.04 | 0.13 |

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

These findings suggest that certain collaboration parameters are associated with specific story features, highlighting the complex interplay between group dynamics, inclusion and the characteristics of the collaborative stories.

Hypothesis 3. Effect of storytelling methodology on group interactions

To investigate the impact of different storytelling methodologies on group interactions, we compared collaborative parameters across three methods: collaborative TDST, collaborative DST, and collaborative TST. Please refer to Table 5 for a comprehensive overview of the results.

Significant differences were observed in the rank totals for the interruption parameter (H = 9.38, df = 2, $p = 0.009$). Post-hoc comparisons revealed a significant difference between cTST and collaborative TDST ($p = 0.004$). Specifically, student's exhibited more interruptions during sessions using cTST (mean = 1.51, sd = 0.51) than during sessions using TDST (mean = 1.19, sd = 0.41).

Further, significant differences were found concerning the level of focus on the task (H = 10.28, df = 2, $p = 0.006$). Post-hoc comparisons showed a significant difference between collaborative TST and collaborative TDST ($p = 0.008$), with participants showing a lower level of focus on the task when creating stories with the traditional methodology (mean = 2.30, sd = 0.53) in comparison to sessions with the TDST device (mean = 2.62, sd = 0.59).

These findings provide evidence supporting the notion that different storytelling methodologies have distinct effects on group interactions, particularly in terms of interruptions and level of focus on the task.

No differences were found between different storytelling methodologies when taking into consideration the Inclusion parameter (H = 0,13, df = 2, $p = 0.94$).

**Table 5** Tangible digital storytelling (TDST), digital storytelling (DST) and traditional storytelling (cTST) averages and differences

| Variable | Methodology | M | SD | Kruskal Wallis Test statistics | Dunn's Test with Bonferroni correction | |
|---|---|---|---|---|---|---|
| Interruptions | TST (during Control & Exp.) | 1.51 | 0.51 | H = 9.38 (df 2), $p = 0.009$** | TST & TDST | $p = 0.004$* |
| | TDST | 1.19 | 0.41 | | TST & DST | $p = 0.57$ |
| | DST | 1.81 | 2.22 | | TDST & DST | $p = 0.15$ |
| Focus on the task | TST (during Control & Exp.) | 2.30 | 0.53 | H = 10.28 (df 2), $p = 0.006$** | TST & TDST | $p = 0.008$** |
| | TDST | 2.62 | 0.59 | | TST & DST | $p = 0.08$ |
| | DST | 2.52 | 0.60 | | TDST & DST | $p = 0.76$ |
| Inclusion | TST (during Control & Exp.) | 2.01 | 0.60 | H = 0.13 (df $p = 0.94$ | TST & TDST | |
| | TDST | 2.06 | 0.47 | | TST & DST | |
| | DST | 2.00 | 0.59 | | TDST & DST | |

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

## Discussion

Our study aimed to investigate the effects of various storytelling methodologies on group interactions, examine the disparities between collaborative and individual stories and explore the relationship between collaboration parameters and story features. The findings shed light on the intricate dynamics of collaborative storytelling and offer valuable insights for researchers and practitioners in this field.

Firstly, the distinct characteristics observed between collaborative and individual stories shed light on the specific benefits of each method in supporting early childhood education. However, individual stories also contained a higher frequency of off-task propositions, potentially suggesting a lack of cohesion and focus on the main story elements. In contrast, collaborative stories displayed higher narrative cohesion, emphasizing the benefits of collective efforts and multiple perspectives in creating a coherent and well-structured narrative. This finding implies that when multiple storytellers collaborate in a shared setting, their collective efforts and contributions lead to a more coherent and interconnected narrative. Collaborative storytelling promotes negotiation, collaboration, and shared understanding among participants, resulting in more cohesive storylines (Burmark, 2004; Kajder & Swenson, 2004; Papadopoulou & Ioannis, 2010). In sum, while individual storytelling allowed for detailed expressions, collaborative storytelling facilitated higher narrative cohesion—a critical skill in social and cognitive development. Collaborative storytelling, therefore, not only supports the development of narrative skills but also enhances social interactions among young learners, promoting skills like negotiation and shared understanding.

Secondly, the correlation analyses between collaboration parameters and story features provided further insights into the interplay between collaboration dynamics and storytelling outcomes. This is particularly relevant in early-stage education, where inclusivity can greatly influence social learning outcomes (Johnson & Johnson, 1989; Laal & Ghodsi, 2012; Stanton et al., 2001). Specifically, the correlations between story cohesion and the involvement of all participants emphasize the importance of inclusivity in collaborative storytelling processes in early-stage education. Furthermore, the balance between positive and negative solutions in the story was found to be strongly related to the inclusivity of the collaborative process, aligning with prior research (Gillies & Boyle, 2010; Johnson & Johnson, 2009; Kagan, 1989). These insights contribute to a deeper understanding of how collaboration parameters influence storytelling outcomes, supporting the significance of H2 in emphasizing the role of collaborative processes irrespective of methodology.

Lastly, our results highlighted the advantages of incorporating tangible digital tools in collaborative storytelling in early education. The use of these tools led to enhanced task-focused attention and fewer interruptions, which are crucial in maintaining young learners' engagement. This aligns with developmental needs at this educational stage, where maintaining concentration and fostering active engagement are often challenging yet critical for effective learning (McDougall

et al., 2018). Our study demonstrates that interactive tools like TDST can significantly aid in meeting these challenges by making learning more engaging and interactive (Sakr et al., 2016).This finding aligns with previous research that emphasizes the benefits of interactive and tangible elements in promoting collaborative storytelling experiences (Garcia-Sanjuan et al., 2018; Schneider et al., 2010). Furthermore, our results indicate that TDST exhibited a higher task focus compared to TST methods. Incorporating interactive features, such as the ability to manipulate characters and backgrounds, into digital storytelling tools can enhance engagement and concentration during collaborative storytelling sessions. These findings support studies that highlight the potential of digital technologies in fostering active participation and sustained attention within collaborative learning environments (Banks, 2012; Cattoni et al., 2024; Faver & Alanis, 2012).

Overall, our study contributes to the understanding of collaborative storytelling by elucidating the impact of different methodologies on group interactions, uncovering disparities between collaborative and individual stories, and revealing the connections between collaboration parameters and story features. These findings can inform the development of effective strategies and tools for facilitating collaborative storytelling in educational, therapeutic, and recreational settings (Menestrina et al., 2021).

The results of our study hold valuable implications for both educators and researchers in the field of education. By highlighting the effectiveness of tangible storytelling and the advantages of combining tangible and digital tools in the learning process, this research offers practical insights. For educators, this study underscores the importance of incorporating tangible tools into educational activities. It demonstrates that tangible storytelling can effectively convey meanings related to various subjects by promoting collaborative knowledge co-construction among students. The heightened student engagement observed during group work, characterized by a strong focus on the task and minimal distractions, emphasizes the significance of planning activities that align with the principles of Universal Design for Learning (Rusconi & Squillaci, 2023; Hartmann, 2015). Teachers are encouraged to explore the potential of tangible and digital tools in their teaching methods, fostering a more inclusive and cooperative environment.

Moreover, the study highlights the enhanced narrative cohesion in stories created collaboratively, reaffirming the value of social interaction in promoting meaningful learning. This finding can inspire educators to consistently encourage group work, cooperative learning, and discovery-based teaching within their activities. By embracing this pedagogical approach, teachers can further recognize the importance of creating an inclusive and cooperative setting, where students become proficient in co-constructing well-structured and cohesive stories enriched with content stemming from the synergy of different imaginations (Völlinger and Supanc, 2020). In essence, our research offers a compelling message to educators, encouraging them to embrace collaborative and inclusive teaching approaches that not only foster meaningful learning experiences but also promote creativity, structure, and cohesion in the narratives co-created by students (Menestrina et al., 2021). Researchers in the field can further explore the dynamics and potential applications of tangible

storytelling within educational settings, enriching the discourse on innovative teaching methodologies.

### Limitations and future directions

It is important to acknowledge the limitations of our study. The sample size and specific context of the study may restrict the generalizability of the findings. Future research could expand the investigation to more extensive and diverse populations and explore additional variables that may influence collaborative storytelling dynamics. Additionally, qualitative analyses and participant perspectives could provide deeper insights into the subjective experiences and perceptions of collaborative storytelling.

While our study aimed to compare the quality of both collaborative and individual stories across different storytelling conditions, we acknowledge the potential confounding effect of multimedia tools. It is essential to recognize the distinction between the impact of multimedia tools and the collaborative teamwork process on story quality. The use of multimedia tools in collaborative storytelling may introduce variables that could influence the outcomes independently of teamwork dynamics. Therefore, future research should carefully consider and delineate the specific contributions of multimedia tools and teamwork to storytelling quality to ensure a more comprehensive understanding of the results.

The duration of the storytelling sessions (1.5 h each) may have affected the findings. Children had limited time for brainstorming, creating, and presenting their stories. This could have had a partially positive impact on the formal and content aspects of the stories, particularly on the development of narrative skills within the group. It would be interesting to extend the duration of storytelling activities to assess the degree of development of narrative and social skills.

In future research, expanding the sample to include a more diverse range of participants would enhance the generalizability of findings. Particularly intriguing would be a comparative study involving students from various educational levels, spanning from preschool to middle school, to explore disparities in both the formal and content quality of stories, as well as the collaboration parameters within groups during story creation. Such a multifaceted investigation could yield valuable insights into the trajectory of storytelling skills and collaborative abilities across different educational stages. Furthermore, delving into potential influencing factors, such as cognitive development and variations in educational curriculum, would provide a deeper understanding of the underlying dynamics shaping these differences.

## Conclusions

In conclusion, this study contributes to collaborative storytelling by providing insights into the effects of different methodologies, the distinctions between collaborative and individual stories, and the correlations between collaboration parameters and story features. The findings underscore the value of incorporating tangible

digital tools and promoting inclusive environments in collaborative storytelling endeavors. These insights have implications for educational settings, therapeutic interventions, and other contexts where collaborative storytelling fosters communication, creativity, and group dynamics.

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**Data availability** The data that support the findings of this study are available from the corresponding author upon reasonable request.

## Declarations

**Conflict of interest** The authors have no conflicts of interest to declare. All co-authors have seen and agree with the contents of the manuscript and there is no financial interest to report.

**Ethical statement** This study was conducted in accordance with the ethical standards of the University of Trento. Approval for the research protocol was obtained from the Ethical Committee of the University of Trento. All participants and their guardians provided informed consent prior to their inclusion in the study. The study adhered to the principles outlined in the Declaration of Helsinki and ensured the confidentiality and anonymity of all participants.



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