TEACHERS' PERCEPTIONS ABOUT COLLABORATION AND INCLUSION USING A TANGIBLE DIGITAL STORYTELLING TOOL (I-THEATRE) IN PRE-SCHOOL AND PRIMARY EDUCATION: THE INCLUDED PROJECT RESEARCH PILOT STUDY

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Abstract

This study analyzes the teachers' perception on the use of i-Theatre, a digital-tangible interactive system. The study involved 40 pre-school and primary school educators in Italy as part of the INCLUDED Project. INCLUDED "Inclusive childhood education supported by multimedia and digital storytelling" is a training and action-research project promoted by the European Commission (Erasmus+) and several institutions and educational centers from Italy, Spain, and Finland. The project aims to favor social skills and narrative competence through collaborative activities using i-Theatre. This tool links the multisensorial dimension of drawing, storytelling, and digital tools in classroom experiences with digital and tangible interfaces. The INCLUDED study is divided into two phases: a pilot and an experimental phase. This pilot study explores the initial contact between students, teachers, and the i-Theatre by examining the teachers' perception on their experience. During this phase, teachers involved in the project had the opportunity to use the i-Theatre tool in their classes and were then invited to answer a questionnaire about their experience. Finally, individual semi-interviews were conducted with a part of the cohort to collect more focused data on their experience. Quantitative and qualitative analysis of questionnaire and interview data was performed. The results show that teachers consider this experience and the i-Theatre tool of high interest for educators, as they report positive effects on collaboration and student engagement from the first session.

Keywords: Tangible Digital Storytelling, Collaboration, Pre-school, Primary School, Inclusion.

1 INTRODUCTION

1.1 Storytelling

Storytelling skills are a set of cognitive and social skills whereby the narrator shares events, representations, memories, beliefs, and fantasies while interacting with the environment [5,22-26,47,48]. Narrative competence is generally developed during early childhood [22,27,47,48] and constitutes a central skill in interpersonal relationships [20,21,29,47,48]. Storytelling methodologies have been increasingly used to work on emotional and psychological content, favor social cognition and empathy [14-19] as well as explore and develop communicative and emotional expression skills [19]; these techniques have also been employed to mediate learners' management of socially problematic situations [15] and to promote the ability to negotiate and convey messages effectively [20,21,47,48].

Nonetheless, there is yet little research that has specifically explored the implementation of storytelling tools like TDST in early educational stages [1,7] compared to the existing literature on the usefulness and implementation of digital storytelling in adulthood and higher educational levels' students [29-35]. One possible reason is that using some type of technological device requires certain cognitive levels and technological literacy which might be reduced in pre-school or primary learners. However, integration of the digital and the tangible provides an opportunity to extend digital storytelling to earlier periods of development. [7,23,36-38]. Similarly, to storytelling and at different age groups, digital storytelling has been found to contribute to favor knowledge-building, sharing [39], developing narrative, linguistic and problem-solving skills as well as creativity [29,40,41]. Moreover, the combination of storytelling and technology has been found to promote the inclusion of students with special needs [42-44] as it favors communication, positive interdependence, and active listening [16-19].

1.2 Tangible Digital Storytelling TDST

Tangible Digital Storytelling applications (TDST) are novel educational devices, and which are yet to be fully explored in their use in the didactic field [1,48]. These devices integrate tangible and multisensory elements into classroom storytelling (e.g., drawings, audio recordings, movements, and dramatization), [2,3]. Moreover, the multisensory dimension of TDST uses the students' senses to engage the learners and enhance their learning experience [2]. The combination of tangible and digital stimuli aims to promote opportunities for learning and collaboration: sensorimotor interaction with digital learning environments [3,48] facilitates the use of TDSTs in pre-school and primary school as well as the applications with specific learning needs [4,48]. The possibility for simultaneous interaction and participation of multiple users [5] with TDSTs results in a less mediated and more accessible application [6].

TDST links digital and traditional storytelling, thus enabling different layers of educational experience such as face-to-face collaboration, tangible, and digital learning environments [6-8]. Digital storytelling is the result of combining traditional storytelling with advances in multimedia technology [9-11]. Nonetheless, traditional storytelling is a powerful teaching tool with fruitful outcomes on didactic and social skills as it utilizes language and dramatization to convey a story, transmit knowledge, share experiences [7,12,13].

1.3 i-Theatre

The i-Theatre (i-theatre.org) is a Tangible Digital Storytelling (TDST) tool, with the appearance of a wooden table, with an integrated multi-touch screen and a scanner-drawer. It allows children to transform their drawings in a digital format and manipulate the character shapes and backgrounds with an elementary gesture vocabulary (move, rotate, zoom). Then, after setting the stage in their desired way, up to five children can tell collaboratively and record their stories (video and audio) by moving the characters on the screen and narrating with their voices.

The actual study reflects the result of a pilot pre-experimental phase of the INCLUDED project (Inclusive Childhood Education Supported by Multimedia and Digital Storytelling, includedeurope.eu), an action-research project (Erasmus+ framework). In this phase, different pre-school and primary schools in Spain and Italy used the i-Theatre, a TDST tool with their students for at least one month.

In this pilot study, we focused on teachers' perceptions about TDST, as those responsible for making decisions about the methodologies and activities to be carried out in the classroom. Teacher's opinions are important because the appraisals and needs of educational professionals play a central role in implementing novel methodologies [45,46].

For this reason, during this study, after the INCLUDED course on TDST [48], teachers involved could use the i-Theatre in their classrooms freely, in any way they consider appropriate, leaving them the freedom to experiment with their students. Thus, advancement in knowledge, technological and methodological innovation may benefit both teachers and students (whether they have difficulty or not), favoring the adaptation of pre-school and primary education classroom environment in terms of technological progress and attending to different social and integration needs.

2 METHODOLOGY

2.1 Design

The study's is cross-sectional using an explanatory sequential design [49] and explores the opinions of 40 pre-school and primary teachers (10 Spanish and 30 Italian) about the usefulness, benefits, and weaknesses of Tangible Digital Storytelling (TDST) in the classroom after a minimum of one month (1 month, 10 Spanish teachers, 25% of the sample; 6-9 months, 30 Italian teachers, 75% of the sample) using the i-Theater device. We collected participants' opinions from an online questionnaire and after we deepened on some volunteer teachers' perceptions through an individual semi-structured interview. Two hypotheses were explored:

1 Teachers consider the experience of their students with the i-Theatre of high interest.

2 Teachers consider that the i-Theatre promotes their students' collaboration, implication, and social skills.

2.2 Participants

The study involved 40 teachers, 37 females (92%) and 3 males (8%) between 27 and 62 years (mean 47,03; SD 9,5). 30 teachers came from two Italian schools (75%), and 10 from two Spanish schools (25%). Spanish teachers were on average nine years younger than Italians (M Spanish: 39,8 years; M Italian: 48,7 years; F (1,35) = 5,52, p = 0,02). Half of the participants had a degree (7,5% a post-graduate title), while 50% had a High School Diploma. Regarding their teaching experience, most of the participants had more of 20 years of experience (48%), ten respondents stated that they had between 11 to 20 years of teaching experience (25%), while 11 had ten or fewer years of experience (6-10 years: 12%; <5 years: 15%). Most of the respondents did not specialize in teaching special needs students (78%). In addition, most of the Italian participants had several co-teaching experiences (70%), compared to none of the Spanish. Finally, most of the Spanish teachers (80%) experienced i-Theatre in pre-school while most Italian (67%) in primary school (Table 1).

Table 1. Teachers who answered the questionnaire.

		Spain	Italy	Total
Teachers	N	10 (25%)	30 (75%)	40
Age (years)	Min	29	27	27
	Max	56	62	62
	Mean	39,8	48,7	47
	SD	10,5	8,6	9,5
	Skewness	0,76	-0,52	-0,38
	Kurtosis	-1,1	-0,04	-0,75
	One-way ANOVA	F (1,35) = 5,52, p = 0,02		
Gender	Female	9 (90%)	28 (93%)	37 (92%)
	Male	1 (10%)	2 (7%)	3 (8%)
Teaching experience	1-5 years	2 (20%)	4 (13%)	6 (15%)
	6-10 years	3 (30%)	2 (7%)	5 (12%)
	11-20 years	2 (20%)	8 (27%)	10 (25%)
	More than 20 years	3 (30%)	16 (53%)	19 (48%)
Educational level	Undergraduate	6 (60%)	14 (47%)	20 (50%)
	Graduate & Postgraduate	4 (40%)	16 (53%)	20 (50%)
Disability specialist	Yes	1 (10%)	8 (27%)	9 (22%)
	Not	9 (90%)	22 (73%)	31 (78%)
Pre-school / Primary school	Pre-school	8 (80%)	10 (33%)	18 (45%)
	Primary school	2 (20%)	20 (67%)	22 (55%)
	Pearson's chi-squared	X^2 (1, N = 40) = 6,60, p = 0.01		
Co-Teaching experience	Yes	0 (0%)	28 (93%)	28 (70%)
	Not	10 (100%)	2 (7%)	12 (30%)
	Pearson's chi-squared	X^2 (1, N = 40) = 31,11, p = 0.01		

2.3 Procedure and instruments

All the participating teachers previously completed the INCLUDED training course about "Approach to inclusive education through tangible digital storytelling" [55] in an online format during 2020. This course aimed to provide a theoretical basis for developing narrative skills, collaborative learning, practices related to the use of storytelling methodologies in the classroom, and inclusion. Subsequently, all teachers received practical training related to using the i-Theatre device before utilizing it in class with their students. Researchers delivered the i-Theatre device to the school with no specific guidelines about the activities, allowing teachers to make free use of the i-Theatre device, adapting it to the content and teaching activities of the different educational levels (pre-school, primary school).

The teacher's perceptions were obtained from questionnaires about TDST methodology, and the i-Theatre device activities carried out in the classroom (organization and duration), students' interest, collaboration and special needs, teachers' support during the task, and its pedagogical value. After, two trained researchers deepened some volunteer teachers' perceptions using an individual semi-structured interview with an average duration of 30 minutes.

2.4 Overview of analysis

Data analysis of the questionnaire was carried out using descriptive statistics (frequency, percentage, and mean score calculations). A summary of the results of the questionnaire items is presented in Tables 2-4 and Graph 1. A 5-points Likert scale was used in all the questionnaire items except for a few items (1-3,6,10) in which a 3-points scale was preferred. In the final analysis, a mean score of 5 indicated positive attitudes, 2 indicated neutral, while 1 indicated negative attitudes. In addition, items 6, 8, and 10 were reverse coded for a higher mean score to signify positive attitudes. Therefore, in all items, a high mean score would stand for a favorable opinion. Since the sample did not have a normal distribution, non-parametric tests were used for group comparisons. More specifically, Mann-Whitney U tests and Kruskall-Wallis H tests were used to analyze the variants among groups by ranks. Significance values have been adjusted by the Bonferroni correction for multiple tests. Finally, the data provided by the teachers' interviews were analyzed qualitatively. The two trained researchers, blind to the hypotheses of the study, carried out: 1) analytical segmentation and identification of meanings; 2) identification of the relationship between codes; 3) aggregation of codes. Researchers aggregated codes through the criteria proposed by Bogdan and Biklen [50]: 1) situations: point of view on a specific topic such as the perception towards TDST activities and i-Theatre; 2) processes: changes that have occurred over time; 3) activities: operating methods such as organization of TDST activities; 4) relations: interaction with colleagues and students.

3 RESULTS

3.1 Questionnaire results

In the first part of the questionnaire, characteristics related to teachers' use of i-Theatre were considered. Results indicate Spanish teachers implemented the TDST activity with i-Theatre in the three grades of pre-school and first grade (from 3 to 6 years). On the other hand, Italians implemented the TDST activity with i-Theatre in primary school (from first to fifth grade, 6-10 years), covering a broad spectrum of pre-school and primary school ages.

As indicated in Table 2 below, while Italian teachers conducted the digital storytelling activity for the entire duration of the academic year (6-9 months), Spanish teachers had a shorter exposure to it (< 1 month). Nevertheless, no significant differences were found between Spanish and Italian teachers' responses to the questionnaire. Moreover, most of the sample (87.5%) used i-Theatre once a week, whereas only five teachers used it at least twice a week. Interestingly, the activity sessions were generally shorter than one hour (85%), while 15% of the sample stated that they used the tool for a longer duration (13%: 60-90 minutes; 2%: 90-120 minutes).

All teachers who carried out the TDST activity with i-Theatre in the pre-school years had indicated a high need of support from students from the first to the last session. However, for both Spaniards and Italians, primary school students needed fewer support, mainly in the first session with i-Theatre and progressively less in the subsequent sessions (Graph 1).

A total of 70% of the teachers involved (80% of the Spanish and 67% of the Italians) reported wanting to continue with the second phase of INCLUDED experimentation.

Concerning hypothesis 1, according to which teachers would consider the experience of their students with the i-Theatre of high interest, results go in this direction. Descriptive analyses of the feedback questionnaire demonstrated that the activity was well-received by the students (Table 3, item 4): 87.5% of the teachers scored their students' level of interest 4 or 5 (item 4, Table 3), while only one teacher reported a lack of interest in his/her students. Interestingly, this teacher only used i-Theatre for less than one month and very brief sessions (30 minutes). Concerning students' skills and capacities (item 5, Table 3), teachers provided positive feedback on average, even considering the adult's level of structure and support (item 9 and 10, Table 4).

Table 2. I-Theatre availability, usage frequency and duration of TDST activity with i-Theatre.

	1 - Low			2 - Medium			3 - High		
	Spain	Italy	Total	Spain	Italy	Total	Spain	Italy	Total
Time i-Theatre at school [1]	10 (100%)	0 (0%)	10 (25%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	30 (100%)	30 (75%)
i-Theatre usage frequency [2]	8 (80%)	27 (90%)	35 (87%)	2 (20%)	3 (10%)	5 (13%)	0 (0%)	0 (0%)	0 (0%)
TDST activity duration average [3]	9 (90%)	25 (83%)	34 (85%)	1 (10%)	4 (13%)	5 (13%)	0 (0%)	1 (4%)	1 (2%)

[1] Score range 1-3 (1= 1 month; 2= from 2 to 6 months; 3= from 6 to 9 months).

[2] Score range 1-3 (1= once a week; 2 = two or three times a week; 3= four or five times a week).

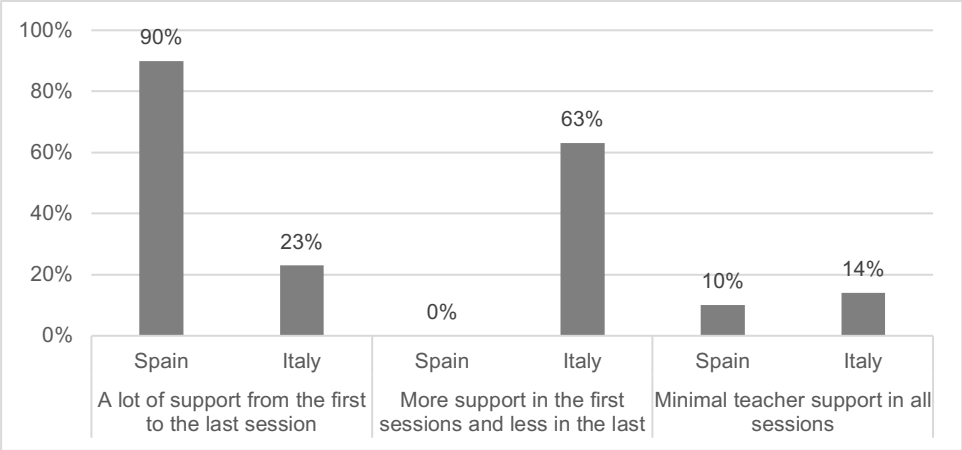
[3] Score range 1-3 (1= 30-60 minutes; 2 = 60-90 minutes; 3 = 90-120 minutes).

Table 3. Student's interest and ability with i-Theatre.

	Spain		Italy		Total	
	Mean	SD	Mean	SD	Mean	SD
Students' interest in TDST activity with i-Theatre (item 4) [1]	3,7	0,94	4,67	0,57	4,27	0,75
Students' ability to cope with the TDST activity with i-Theatre (item 5) [2]	2,7	0,94	4,4	0,67	3,97	1,04

[1] Score range 1-5 (1 = no interest; 2 = a little; 3 = sometimes; 4 = often; 5 = always).

[2] Score range 1-5 (1= not able; 2 = a little; 3 = sometimes; 4 = often; 5 = always).



Graph 1. Teachers' support to students during TDST activity with i-Theatre.

Concerning hypothesis 2, according to which teachers would consider that the i-Theatre promotes their students' collaboration, implication, and social skills, results go in this direction (Table 4). Crucially, the TDST activity (item 11, Table 4) had a positive general pedagogical value, comparable between groups (M=3.9; SD= 0.8), where 82.5% of the sample scored 4 or higher. Additionally, most teachers judged the collaborative value of the training as high (item 12, table 4, item 12: M=3.95; SD= 0.78) as confirmed by participants' positive answers at items 7 and 8 (table 4). Specifically, most of the teachers declared that the storytelling activity with i-Theatre could foster collaboration among the participating students (item 7, Table 4; Mean= 4.3; SD= 0.9), without enhancing the level of competitiveness among students (item 8, Table 4; Mean= 2.5; SD= 0.8). Finally, in terms of group comparisons, preliminary non-parametric tests indicated that - concerning teachers' level of education, Bachelor' degree holders assigned a higher cooperative value to the i-Theatre activity (p=0.009) compared to the other two groups. However, no significant differences were found between MA holders and postgraduates (U=215, p=0.64). Similarly, regarding the teachers' role, it appeared that primary school teachers had, on average, more positive attitudes than teachers who worked at pre-school (U=267, p=0.043).

Table 4. Pedagogical utility of TDST activity with i-Theatre.

	Spain		Italy		Total	
	Mean	SD	Mean	SD	Mean	SD
TDST activity with i-Theatre can foster collaboration? (item 7) *	3,6	1,1	4,5	0,6	4,3	0,9
TDST activity with i-Theatre encourages competitiveness? (item 8) *	2,5	1,2	2,5	0,7	2,5	0,8
Order during TDST activity with i-Theatre (item 9) *	3,6	1,3	4,0	0,7	3,9	0,9
Teacher's rules for regulation during TDST activity with i-Theatre (item 10) *	1,9	0,8	1,6	0,7	1,7	0,7
Pedagogical utility of TDST activity with i-Theatre - Curricular objectives (item 11) *	3,6	1,0	4,0	0,7	3,9	0,8
TDST activity with i-Theatre usefulness on student's social skills and cooperation (item 12) *	3,5	0,7	4,1	0,8	4,0	0,8

** Score range 1-5 (1= very low/very unsatisfactory; 2= low/unsatisfactory; 3= moderate/sufficient; 4= high/good; 5= very high/good*

3.2 Interview findings

A total of 10 class teachers (9 female, 1 male; 6 from Italy, 4 from Spain;) were interviewed, aged between 39 and 50. None had the special ed credentials while they all had co-teaching experience. Of the 10 interviewees, 7 out of 10 had more than 20 years of teaching experience and most of the cohort (8 out 10) had an MA in Education. Below, findings from the coding of interviews with 10 teachers: 5 thematic areas emerged from the analysis (see Table 5). Some descriptive quotes of the content provided by the teachers for each of them have been transcribed in this section.

Table 5. Constructs emerged from interviews.

Constructs	Meanings
Task setting and delivery	How teachers planned and carried out TDST activities using i-Theatre
Pedagogical potential	Potential of TDST activities using i-Theatre in relation to pupils' learning
Emerging skills in children	Teachers 'perception of students' skills after TDST activities and i-Theatre
Inclusion	Teachers' perceptions on inclusion of children with special needs
Difficulties	Technical and organizational problems encountered during TDST activities using i-Theatre

3.2.1 Task setting and delivery

The structure of the TDST activities planned by the teachers varied according to the age of the children.

With pre-schoolers, activities mainly concerned the exploration of the i-Theatre device: 1. *"They didn't elaborate stories: they used the touch screen to work on concepts such as near-far, large-small, or counting with images previously scanned by the teacher".* 2.*"It became a space of welcome. Then they started to tell stories."*

Activities were usually carried out in small groups rotating around the i-Theatre instrument*."* 1. *"Once a week we work with the class. In a small group… 4 children. If they are older...even 5/6 years.*" 2. *"Only 3-4, children...Then I increased the number. It depends on the structure of the classroom."*

In primary school, some teachers carried out TDST activities with the use of i-Theatre to consolidate topics concerning a specific discipline: 1. *"The activity consisted in recording a summary of a didactic science unit in English."* 2. *"We did a civic education project. We focused on taking care of a planted seed that slowly grew."*

3.2.2 Pedagogical potential

All teachers showed great enthusiasm for the use of i-Theatre and TDST activities in the classroom. According to all the teachers, such activities promoted fun leaning opportunities allowing for self-expression: 1. *"It was an enriching and satisfying experience."* 2. *"These activities gave the possibility*

to express oneself in various ways." 3. *"Extremely fascinating. I like the idea of digital education".* 4. *"The result was frankly better than I expected."*

In particular, the i-Theatre tool was considered beneficial, original and innovative because it favors the co-construction of the knowledge: 1. *"It is a new way of thinking about the school using new tools. It is not the smart-phone but a tool where knowledge is built and does not isolate you, but it allows you to do things together."* 2. *"It is very eye-catching. We presented it as a tool for creating cartoons. It makes them feel involved."*

For some teachers, the i-Theatre tool was also helpful because it combines a digital approach with a traditional one: 1. *"It helps creativity, fine motor skills, the digital approach, the integration of the voice with the recording."* 2. *"Students are always experimenting things that they already do classically."*

3.2.3 Emerging Skills in Children

Some interviewees reported that skill developed using i-Theatre concerned collaboration and reciprocal interaction: 1. *"Each child brings its contribution."* 2. *"Collaboration in general. They respected their turn, listened to their partner's recording."*

Others added that TDST activities fostered the ability to listen and respect the contribution of all children: 1. *"The children were participatory and active, and this helped the communication between them."* 2. *"They collaborated and developed skills such as patience and active listening."*

One teacher said that the experience was also helpful to resolve conflict: 1. *"The students tried to resolve conflicts in the group through storytelling."*

3.2.4 Inclusion

As for learners with special needs, TDST activities with i-Theatre favored inclusion in the classroom context by means of engagement: 1. *"Children with special needs who have no linguistic skill used the tools because they were attracted to technology."* 2. *"The curiosity to touch and to see for special needs children was important."* 3.*"Our special child can't speak well, but he moved the characters."* 4. *"It is a visual and intuitive tool for children with learning difficulties. The tool maintains everyone on the same level."* 5. *"Those who are often left behind have seen the possibility of doing things. They have been happy with the result of their work."*

3.2.5 Difficulties

One teacher did report some initial problems with TDST activities due to the lack of technological skills: 1. *"My difficulties in using the tool? As I'm used to working with PC programs, it took me a while to understand how it works.".*

Another problem was related to the duration of the activities, since many schools only have one tool for several classes*:* 1. *"A child with special needs initially rejected the activity and did not want to do the activities in the following sessions. This particular student would have needed to use the tool many times to familiarize with it." 2."The use of the tool should be continuous throughout the course so that challenge levels can be progressively increased.".*

4 CONCLUSIONS

The study aimed to explore the opinions of pre-school and primary teachers regarding the usefulness of Tangible Digital Storytelling (TDST) after using the tool (i.e., i-Theatre) for at least one month.

Results from questionnaires and interviews underlined that teachers consider the experience of their students with the i-Theatre of high interest. Furthermore, the TDST activity was well-received by the students, as teachers reported high levels of appreciation in their students. These results align with other findings [7,23,41-44], which repeatedly suggested TDST training can promote skills development while boosting students' motivation and engagement.

As regards the teachers' role (support and structure during the TDST activities), primary school teachers had, on average, more positive attitudes than teachers who worked with younger students. This result can be because primary school students are generally more independent than pre-school students. In addition, it should be considered that the development of narrative competencies occurs progressively throughout development [22,32,52-55], so the ability to tell stories in pre-school courses is lower compared to primary school students [22,32,52-55].

This exploratory study confirmed teachers' positive attitudes towards digital storytelling activities [7,14-19]. Specifically, teachers considered i-Theatre to promote their students' collaboration, implication, and social skills. In addition, most of the teachers emphasized the pedagogical value of the experience as high or very high and considered the tangible digital storytelling activity as valuable to foster collaboration among students.

4.1 Limitations and future directions

Health restrictions due to the 2020-21 COVID-19 pandemic limited the sample size of this study, reducing the number of schools and teachers who could access the i-Theatre device. Furthermore, results about Tangible Digital Storytelling activity with i-Theatre in the classroom are entirely based on the information provided by the teachers.

In future studies, it will be necessary to deepen the information by direct observation of the activities in the classroom in-situ with structured planning of activities, which allow the comparison between the different schools, methodologies, and educational stages. With this objective, the results of this pilot pre-experimental phase must be supported by a following experimental phase, assessing students' initial competencies and their evolution after carrying out collaborative storytelling activities using different methodologies (traditional, digital-only, and tangible digital) to compare differences in their pedagogical effectiveness for skill development and inclusion.

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