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The storythinking programme: a framework for nurturing critical thinking in preschool

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ABSTRACT

The Storythinking Programme, focusing on oral storytelling, was designed to investigate critical thinking skills and pedagogical practices to nurture these skills in preschool children. The aim of the study was twofold: (1) to clarify what type of skills preschool children use and (2) to explore those teaching practices that nurture these skills. One of the study's central claims, examined from a sociocultural lens, is that children from age 3 begin to engage in critical thinking with adult scaffolding and peer support. The paper reports fine-grained evidence of specific critical thinking skills in children aged 3–5 years, gathered using a Design-Based study in 2 classrooms involving 17 preschool children and 2 educators. An in-depth analysis of the pedagogical practices necessary to provide the scaffolds and the space within which these skills can emerge is presented. The pedagogical approach leverages established practices in early years in a novel way to best support the emergence of young children's critical thinking skills. The findings provide strong evidence to support the conclusion that preschool children think critically under specific pedagogical conditions.

KEYWORDS

Preschool children; critical thinking; oral storytelling; dialogic inquiry; design-based research

Introduction

Critical thinking (CT) is at the forefront of learning and gaining increasing attention as a twenty-first-century skill that positively impacts students' learning and life opportunities. For decades, researchers have suggested that CT should be taught at all levels of education and, if practised, it will develop throughout a lifetime (Pithers and Soden 2000; Thompson 2011). CT appears increasingly in educational documentation at a research and policy level in primary and secondary schools (OECD Team 2019; Vincent-Lancrin 2022). While some research suggests that CT in young children is widely documented (Pollarolo et al. 2023), others report that empirical evidence on CT is very limited for young children (O'Reilly, Devitt, and Hayes 2022). The disparity may be related to the terminology adopted and how closely related CT is to other cognitive processes. To delineate CT in relation to common terms used across ECEC, the next section will situate CT in the context of the present study.

Cognition and young children

In early childhood, there are many different ways to conceptualise and explore young children's thinking including:

- Sustained Shared Thinking: the interactive process where a child or adult collaboratively explores ideas, solves problems and has meaningful conversations (Purdon 2016; Siraj-Blatchford et al. 2008).
- Metacognition: the awareness and understanding of one's own thought processes (Chatzipanteli, Grammatikopoulos, and Gregoriadis 2014).
- Theory of mind: our understanding of people who each have their own mental states (e.g. thoughts, beliefs, feelings) (Astington and Edward 2010).
- Higher-order thinking: The ability to analyse, evaluate, synthesis and problem-solve (Ichsan et al. 2021).
- Generic thinking skills: can include information processing, reasoning, inquiry, creative and critical thinking (Taggart et al. 2005)
- Creative thinking: the ability to generate original ideas and use one's imagination to explore possibilities (Nikkola, Reunamo, and Ruokonen 2022).

CT is challenging to define in early childhood and encompasses a mix of skills, abilities, and dispositions to think in a particular way; in this sense, CT taps into cognition and behaviour (Davies and Stevens 2019; Ennis 1985; Lai 2011). This paper focuses on CT skills and not thinking dispositions; it acknowledges that the concepts are interrelated (see Ennis 2011; Facione 2011; Leś and Moroz 2021).

The following elements are considered part of CT:

- Analysing, evaluating, and considering information from different viewpoints (Elder and Paul 2007; Paul, Niewoehner, and Elder 2019).
- Inferring using inductive or deductive reasoning (Ennis 1985; Willingham 2007).
- Applying reason and logic to make judgments and draw conclusions (Lipman 1997; Paul, Niewoehner, and Elder 2019).
- Problem-solving through the process of analysing all available relevant data (McCormick, Clark, and Raines 2015; Snyder and Snyder 2008).
- Purposeful, self-regulatory judgement which results in interpretation, analysis, evaluation, and inference (Davies and Stevens 2019; Facione 1990).

One of the difficulties in defining CT in preschool children is the lack of a specific early childhood CT framework. To investigate this issue, this paper reviews current literature on CT.

Pedagogical approaches

Various strategies have been used to understand how best to scaffold CT skills in children including: Questions and inquiry, the notion of language as pedagogy and storytelling.

Questions and inquiry

The literature on questions and inquiry as pedagogy in the classroom is extensive. Inquiry-based pedagogy has found that children make connections to learning when the information is clearly explained (Karadağ, Demirtaş, and Yıldız 2017). Others have found children generate more complex ideas when working in large group-work compared to small group-work (Polat and Aydın 2020). This research highlights the social element of cognitive development which aligns with Vygotsky's theory that cognitive development is socially mediated through collaborative dialogues (Alexander 2020; Taber 2020). Pedagogical approaches vary in application but most involve engaging with children using questions and responses to scaffold concept formation that aids problem-solving (Fisher 2013). Collins (2016) suggests that high cognitive demand encourages children to reason, analyse, summarise and explain story content. While scholars agree that questions scaffold developing CT, they emphasise that while questioning techniques can be powerful methods of prompting thinking, the types of questions presented must be carefully considered (Säre, Luik, and Fisher 2016; Säre, Tulviste, and Luik 2019). Furthermore, Pantaleo (2017) highlights that only samples of children's thinking are visible when they answer questions. This finding supports the notion that a combination of teaching strategies is necessary to support overall learning.

Language as pedagogy

CT is visible through language when information is shared and critically analysed verbally. Therefore, educators who intentionally use language can embed CT into classroom culture (Salmon 2008). In the early years, it is essential to teach children how to express their thoughts and emotions. The literature suggests that words like 'not', 'or', 'same', 'different', 'happiness', 'sadness', and 'anger' are vital for helping young children express thoughts and feelings and understand others' viewpoints (Aras and Aslan 2018; Cesur and Yaralı 2020). Moreover, exposing children to a range of specific words significantly enhances cognitive development, making them better problem-solvers (Marić and Sakač 2018). Given that early childhood settings revolve around classroom conversations, it is crucial to pay attention to mindful language (Kelley 2018).

Storytelling

The use of storytelling in education varies across settings. Research has found that picturebooks can enhance primary school children's CT (Roche 2015); shared book reading with a peer can support reasoning (Reed et al. 2015), and the combination of storytelling and drama can help children understand complex topics (Walan and Enochsson 2019). Papadopoulos and Bisiri (2020) found an improvement in children's CT following engagement with fairy tales and folk tales. However, CT was expressed as a broad, umbrella concept lacking information on the specific skills children employed.

Models of storytelling as pedagogy have been highlighted in the work of many. For example, Vivian Gussin Paley, storytelling curriculum involves the child as the creator of the story, where the model nurtures creativity and social and language development (Paley 1981, 1986, 1991). Playworlds, an aesthetic play pedagogy developed by Lindqvist (2003), uses stories to create imaginary situations and focuses mainly on the interactions

between the child and the adult (Urban et al. 2012). In addition, oral storytelling focusing on fairy tales has been used in education to instil character values as children make judgements based on actions portrayed as story plots evolve (El'Koninova 2001; Rahman 2017).

Strelkova (2021) explored the function of fairy tales in developing empathy with 20 preschool children. Findings indicate that to prepare children for a deep understanding of a fairytale in ways that will elicit appropriate emotional responses, the educator needs to pay specific attention to the story delivery process and interaction. The current study extends what we know about storytelling by testing its power as a pedagogy to nurture CT in preschool children.

Towards a definition of CT in early childhood

A recent review of CT suggests that there may be as many definitions of CT as there are scholars who write about them (Alsaleh 2020). For this study, we draw on the Critical Thinking Framework developed by Paul and Elder (2019); the framework, developed for older students and educators, was adapted to accommodate early years literature. According to Paul and Elder (2019), eight elements are used to reason, and reasoning is necessary for all CT. The elements in the Paul and Elder Framework [Table 1] are relevant when we view children as competent thinkers who can and are willing to adapt to new and novel pedagogies (Taggart et al. 2005).

Of the eight 'Elements of Thought' listed in Table 1, two elements, Concepts and Purpose, were modified for the current study. Concepts were adapted to include data incidences where children were observed reasoning or problem-solving. The purpose was adapted to include incidences where children were observed reasoning or problem-solving. The rationale for adapting the elements was to include common terminology associated with CT in the ECEC literature (e.g. O'Reilly, Devitt, and Hayes 2022).

Theoretical perspective

Framed within a sociocultural view of learning and development, preschool children are understood to develop the competency and ability to engage in critical thinking with the help of more capable others (Vygotsky 1978). Collaborative supportive learning environments can move thinking and understanding from the unknown to the known (Holzman 2018).

Method

Participants

The study involved two groups of participants from one preschool in Southern Ireland. Group One involved six children (mean age 45 months) and their educator, and Group

Table 1. Elements of Thought (Paul and Elder 2019).

(1) Information: needed to answer a question	(2) Concepts [Reasoning or Problem-solving]: ideas we use or generate in thinking
(3) Questions: things we try to answer	(4) Assumptions: taking for granted
(5) Point of view: things we need to consider	(6) Purpose: why we are thinking
(7) Inferences: or conclusions we are coming to	(8) Implications and consequences: of our thinking

Two involved 11 children (mean age 55 months) and their educator. The educators took the role of storyteller and facilitator of the Storythinking intervention. The researcher worked on-site with the educators.

Ethics

This study commenced by obtaining ethical approval from the relevant ethics committee. Before proceeding, children, families, and educators interested in participating returned signed consent forms. Participants were given detailed information booklets describing all aspects of the study. Data was confidential, with pseudonyms used to protect anonymity and all data secured on password-protected devices.

Research design

The research adopted a Design-Based Research (DBR) approach (Bakker 2018). DBR is a form of experimental interventionist research in which data is generated during iterative rounds of collaboration, implementation and analysis combined to inform the research design. DBR is often used in educational settings when the objective is to examine real-world practices to improve teaching and learning (Barab and Squire 2016; Dolmans 2019).

Procedure

- This was a 10-week DBR intervention.
- Before the programme commenced, the educators received training in oral storytelling and dialogic inquiry.
- The educators selected the stories.
- Dialogic inquiry and questions are applied as pedagogical strategies.
- Children are invited to collaborate and interact during the storytelling.
- The design evolved through a collaborative, iterative research process.

Data sources

In this experimental interventionist research, data was transcribed and analysed, generating patterns and coded data throughout the 10-week study. This data was shared with the participating educators for feedback during collaborative research meetings. Instruments of data triangulating included:

- Classroom observations.
- Video-audio recording.
- Collaborative research meetings were held at weeks 3, 7 and 10.

Design process

The Storythinking Programme had three core pedagogical characteristics: (1) utilise oral storytelling and (2) incorporate dialogic inquiry, to (3) nurture emergent CT. The conjecture was that critical thinking could emerge through engagement with story content

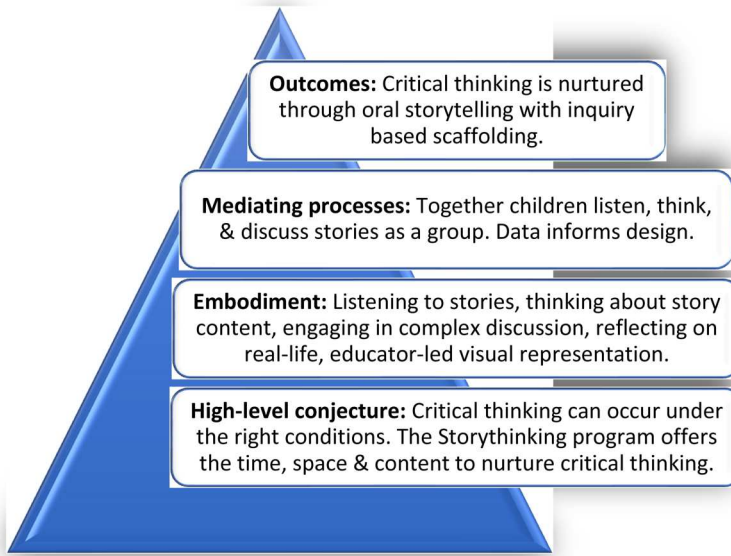


Figure 1. Conjecture map.

(Fisher 1999, 2013) enhanced by the power of dialogic inquiry (Alexander 2020; Mercer and Littleton 2007).

This study focused on the art of oral storytelling as a scaffold for CT. Thus, the pedagogical approach leverages established practices, adding a novel element of traditional storytelling. In line with DBR, an initial conjecture was developed, as illustrated in Figure 1; it was foreseen that the conjecture would evolve during the iterative cycles of implementation and analysis.

Limitations

Some limitations are noted. The study was a small-scale sample; therefore, the findings cannot be generalised. Furthermore, DBR requires the researcher to take a dual role in design and data analysis, which can lead to researcher bias. Additionally, the authors align with Paul and Elder's (2019) critical thinking framework, which could have influenced the coding process. To limit biases, data triangulation involved constructive collaborative feedback from a research team (see Turner, Cardinal, and Burton 2017).

Findings and discussion

The data analysis followed the reflexive thematic analysis developed by Braun and Clarke (2021), which resulted in a number of themes and subthemes. Due to the scope of this paper, only a sample of findings can be reported; for more detailed findings, see O'Reilly (2024). Appendix reports the number of times individual children verbalised elements of CT. This section will report on two features: (1) the elements of critical thinking and (2) the conditions for critical thinking.

The elements of critical thinking

Due to a limited word count, this article will address the elements of CT observed in children under the following headings information, questions, inferences, points of view, and reasoning or problem-solving. Further information on elements of critical thinking is available in O'Reilly (2024). The number of times each child engaged in an element of CT is reported in Appendix A, [Figures A1](#) and [A2](#).

Information

Incidences of information were recorded as a part of CT when it was communicated with clarity and accuracy and if it was relevant to the group discussion, as discussed in Paul and Elder (2019). In the study, children used information in multiple ways to engage with the story, their peers and their educator. For example, to clarify something, ask questions, or even argue with the educator if they disagreed with her story interpretation. Further, data shows how children drew on their prior knowledge to build connections between real life and the stories. An example of children using information is illustrated in how Jack and Bob interact during *The Gingerbread Man*:

- Educator: might she have kept him there and had him as a little boy?
 Jack: I think, cause, cause, the gingerbread man wanted to run away to get to the street.
 Educator: What do you think the cows and the horse might have done if they caught him?
 Bob: Em, em, jump up.
 Educator: What would you have done?
 Bob: How about I would let him pass?
 Jack: Em, em, eat him.
 Educator: What makes you think they would eat him?
 Jack: Cause, cause, em ...

It is widely accepted that sharing information and communicating with clarity and accuracy are skills that set the foundation for thought and language development (NCCA 2009; Vygotsky 1997). During the study, all children demonstrated the skill of presenting accurate, clear, and relevant information. However, the children with high-level verbal interaction demonstrated more aspects of this skill than their peers. This finding highlights a potential problem: How do we identify and support CT in children who do not verbally interact?

One way this problem was addressed as the study evolved was to provide space for the quieter children to have their voices heard. Thus, the educators would look at specific children and ask them questions at appropriate times during the stories. This interaction included two pedagogical elements: dialogic inquiry and intentional thinking language. The following example illustrates what this practice looked like in real time:

- Educator: Louie, what did you think of that story?
 Louie: Nods to indicate yes
 Educator: What did you like about it?
 Louie: The Gingerbread man?
 Educator: Oh, me too. What did you like about the Gingerbread man?
 Louie: He ruined away (Louie laughs).

This type of interaction aimed to gently engage children less inclined to speak in the group discussion. Findings indicated the need to create a space for all the children in the

group to communicate and interact, sharing thoughts and ideas as a starting point to develop complex ways of thinking. Without the educator's facilitator role, some children are more likely to dominate the discussion than others. It is important to create this space in a group setting recognising that CT can develop when the opportunity to share information arises and is considered from different viewpoints (Paul, Niewoehner, and Elder 2019).

Questions

When children ask questions unprompted, they display dispositions of curiosity and exploration linked to CT (Davies and Stevens 2019; Lai 2011). Some of the children asked questions when they needed clarification or if they disagreed with the story's content, indicating an understanding that not all information is accepted at face value. Learning to filter information and decide what to believe and reject is a core element of critical thinking (Ennis 2011; Facione 2011). During the tale 'The Wind and the Sun' Dan displays CT by questioning the credibility of the educators ending:

- Educator: Do you know why the sun got the man to take his coat off?
 Louie: Because it was too hot.
 Dan: 'But why? Cause the wind is stronger'.
 Educator: 'So tell me, was the wind able to get the coat off?'
 Dan: No, cause he was holding on tight, but that was cheating'.

The discussion with Dan continued and his peers joined in. The interaction made clear Dan's confusion and the cognitive effort it took to make sense of the story. Dan reasoned: *The wind can blow down houses and make waves, the sun can't, the wind is stronger.* According to Alexander (2020), providing the time and space for learning, by talking and thinking in groups, scaffolds intellectual development. In the example with Dan, rather than focusing on teaching scientific concepts, such as *the sun and the wind*, the educator focused on supporting Dan by sitting quietly while he processed the challenging story content. Thinking time is known to support children's cognitive processing (Rowe 1986; Stahl 1994).

Inferences

Children made inferences and very often developed the inference to make a judgement. In incidences where children's inference developed into a rationale, evidence from data indicates the prerequisite was the educator's questioning approach. For example, when asked, *Why do you think that?* rather than say *I Don't Know*, the children often developed their ideas. A sample of language used that was coded as inference is shown:

What if, what if ..

Maybe.. I think ...

Or maybe ...

Oh, I think, oooo maybe ... em

Inferencing to support reasoning and problem-solving are established elements of emergent CT (Davies and Stevens 2019; Facione 1990).

Points of view

During the story and at the end, the children discussed different views of the characters and the plot. Some children spontaneously engaged while others needed to be asked directly, ‘What do you think?’. CT was not always present. CT was evident in two conditions: (1) questioning and (2) dialogic inquiry. Dialogue inquiry may involve communicating in the following way:

- Educator: *Gosh, I wonder what might have happened if the pigs were not home!* Following this inquiry, the educator will pause to allow the children to interact. If the children do not interact after 3 s, the educator will continue with the flow of the story.
- Educators’ Questioning: *Can you think of something else he could have done?* Again, a 3–5 s pause follows this line of engagement.

The evidence clearly demonstrates that when children are prompted with questions, they show a willingness and ability to think deeply and provide logical answers. Further examples illustrating this phenomenon will be presented in the upcoming sections. The findings from the current study are validated by research indicating that questioning approaches can enhance children’s cognitive development (Collins 2016; Fisher 2013; Marić and Sakač 2018).

Problem-solving

Children often display criticality in their problem-solving, sometimes alone, other times collaboratively. For instance, when asked what the lion would do if the mouse hadn’t helped, Bob came up with a unique solution:

- *He might have to buy a new tooth.*

Later, Bob suggested:

- *If you do snap, snap, snap, your tooth might fall out.*

In the second attempt to solve the crocodile’s problem, Bob used his body to show how it may be possible to lose a tooth by trashing around. Drawing from prior knowledge, this is logical thinking for a 4-year-old.

During ‘The Fox and the Hen’ the children problem-solved as a group. The following excerpt illustrates the collaborative construction of knowledge generating many logical problem solutions:

Educator: The fox could not reach the Hen. What do you think he will do?
 Colm: How a ladder
 Amy: A Ladder
 Larry: Ring a Fireman
 Colm: Eh, no get Daddy
 Anna: Or Spiderman
 Colm: How about climb up the wall

This type of dialogue occurred often. Sometimes, educators led; other times, children led. Findings indicate that elements of CT followed an encouraging prompt from the

educator. In some data when children reasoned, there was evidence of multiple parts of thinking as illustrated in the following excerpt:

Educator: Was there a baddy in the story?
 Amy: Yes.
 Educator: Who was the baddie?
 Amy: The mammy.

The educator was surprised by this answer and asked, *Oh, can you tell me why?*

Amy reasoned: *cause the mammy kicked her little pigs out of the house, and my big brother lives with me, and my mammy would not do that, the mammy is mean.*

Amy's information was clear, accurate, and relevant. Drawing from her own experience, she evaluated the information and came to a reasonable and logical conclusion. This data represents many parts of what scholars have described as CT (Ennis 1985; McCormick, Clark, and Raines 2015; Willingham 2007).

Conditions for critical thinking

This section addresses the conditions for CT generated through data analysis under the headings of oral storytelling, cognitive and dialogic inquiry, and language as pedagogy.

Oral storytelling

Oral storytelling can capture children's attention and provoke complex thoughts (Landrum, Brakke, and McCarthy 2019; Phillips 2013). Story content is the material the educators were asked to use to probe children's thinking and take them from their current state of thinking through the intentional use of dialogic inquiry towards a more profound way of thinking, as seen in research by Fisher (1999, 2013, 2018).

According to the literature, for children to discuss a story, it must be told so that they will listen to the content from beginning to end; in addition, the educator must skilfully create the events of the story in a way that stimulates the children's curiosity and creative minds (El'Koninova 2001). During this study, the children's responses and critical engagement in the story plot validated that oral story content provided ample material, allowing for critical story discussion. Moreover, occasionally, children were critically engaged with the story without adult intervention. For example, the following excerpt illustrates three children co-constructing ideas during 'The Fox and the Hen':

Educator: The fox was thinking ...
 Bob: Oh, how about getting a ladder?
 Educator: Oh, a ladder would have been a good idea.
 Daisy: Or get Spiderman.
 Bob: No em, no get daddy.
 Colm: Ring the fireman to get a ladder.
 Bob: Or climbed the wall with the ladder.
 Bob: Or, get scaffolding, my daddy has scaffolding.

In contrast, during the tale 'The Crocodile and the Mouse', the educator needed to facilitate and ensure every child could have the opportunity to interact.

Educator: ... and then they all shared the watering hole together.
 James: I know I know.

Educator: ... and they lived happily ever after.
 James: I know.
 Mary: Hey hey.
 Educator: James and then your turn, Mary.
 James: They could bring toys to play with.
 Chrissy: Or bring a crocodile toy and put that in the water.
 James: ... and the crocodile swimming in the water.
 Mary: *You could snap your fingers.*

The data clearly demonstrates that, as proposed by El’Koninova (2001), effective storytelling is crucial for capturing the attention of children. Nevertheless, there is also evidence indicating that some days, if a child in the group is not in the mood for a story or unwilling to wait for their turn to speak, it may lead to disruption. This potential challenge within the Storythinking program is effectively addressed through affective scaffolding, where educators leverage their professional expertise to support the group’s well-being and address their social and emotional needs (see NCCA 2009), drawing from the pedagogical practices integrated into the Storythinking program.

Cognitive scaffolding and dialogic inquiry

The educators’ practice of cognitive scaffolding was observed in incidences where they used language to move children’s thinking from assumptions to generate more complex understanding (Holzman 2018; Vygotsky 1997).

To stimulate challenging communicative interaction, the educators employed dialogic inquiry. For example, the educator would say, *‘I wonder why that happened’*, followed by a brief pause to allow the children to respond. Additionally, the educator would pause during a story and ask the group, *‘Do you think that was a good idea? Is there something else the Big Bad Wolf could have done instead?’* This line of inquiry has been demonstrated in the current study to encourage emergent critical thinking in participants. This finding is supported by existing literature that proposes that during story discussions, young children exhibit various aspects of cognitive engagement (Agosto 2016; Phillips 2012; Phillips and Nguyen 2022).

Across the 10-week study, the seventeen children openly engaged willingly and often. However, five of the children asked questions more often than their peers to gain clarity (see Appendix). This study’s findings demonstrate that the more verbally interactive a child is, the more evidence of emergent critical thinking can be generated. In contrast, children who verbally interacted less often than their peers had fewer observations of active engagement in critical thinking. This finding is crucial to the present study where language was required to assess CT. The cognitive skills discussed in this paper were observed in the verbal interactions of the children.

In teaching children to think, they must not be given the answers; instead, what is required is the time and space to work things out (Alexander 2020). Again, there was significant data to demonstrate that children responded well to the following line of inquiry:

- What do you think?
- Oh gosh, I wonder what might happen!
- Should we ask your friends what they think?

- Is there another way to solve the problem?
- What would you do if it happened to you?

The study's findings support Vygotsky's theory of cognitive development as socially mediated, drawing together the elements of thought, language, and collaboration (Ferryhough 2008).

Language and time

The characteristics of this study are intertwined and cannot be reported in isolation. Language and cognitive scaffolding were interdependent and used to introduce children to the idea that critical thinking is not the same as passive thinking; the educator was required to model (1) thinking language and (2) facilitate thinking time.

Thinking language: Modelling thinking language has been shown to positively enhance children's understanding of thinking words and processes (Karadağ, Demirtaş, and Yıldız 2017; Kelley 2018; Marić and Sakač 2018). For the Storythinking Programme, the educator was required to blend thinking words into the story activity. Instead of saying 'the little pigs set out to build a home of their own', the educator may say, the little pigs thought, I wonder what we should do now?

Thinking time: Research has suggested that when children are given 3–5 s of silence after a question is asked before responding, they are more likely to provide a considered response over saying, 'I don't know' (Rowe 1986; Stahl 1994). In line with prior literature, pausing after asking questions positively impacts students' responses (Rowe, 1986; Stahl 1994). Supported by previous research, the classroom interactions involving educator-child and child-led questions and inquiry in combination with modelling thinking language worked together to support the development of critical thinking (Alexander 2020; Mercer and Littleton 2007; León 2015; Vygotsky 1978). The following snapshot illustrates how 'thinking time' was perceived in the context of the study:

Example 1: Dan: But, but, that isn't what, what ...

In this incident, Dan pauses to articulate his thoughts because the educator told his story differently from what he expected. In the collaborative research meeting with the educator following this story, the educator was reminded to pause for three seconds at appropriate moments when children wish to address a question or share a thought.

Example 2: Educator: Guess what was in the bag ...

Colm: I don't know emmmm ...
 Educator: Something heavy ...
 Colm: Oh, oh rocks.

Because the educator prompted and then paused, Colm had the opportunity to think and express his thoughts. According to Rowe (1986) and Stahl (1994), the quality of classroom discussion can be increased by allowing time for students to process information before the educator continues with a discussion or lesson. Whilst thinking time was deemed necessary for cognitive processing and embedded in the pedagogy of the current study, there was no significant data to confirm if 'thinking time' impacted emergent critical thinking. These findings indicate an area for further research.

Table 2. Design principles.

Stage	Principle
1	Traditional beginning Once upon a time ... Introduce the characters and the setting. Describe these in detail to help children build a mental picture.
2	Stimulate curiosity I wonder what this story is about! Would anyone like to predict? Okay, lets continue. And hear what happens.
3	Traditional middle Introduce the main event, every good story has this.
4	Scaffold critical thinking Was there a problem in that story? Why do you think ... ? How did the other characters feel? What makes you think that? Was that the best thing to do? Is there another solution ... ?
5	Traditional ending The wolf ran away and the pigs were safe.
6	A new beginning What do you think happened the next day?

The findings from the DBR intervention highlight language as both a strength and a barrier when considering how to develop CT in preschool children. These findings raise two questions that merit future research:

- (1) How do we support children who do not verbally communicate to engage in critical?
- (2) How do we access emergent critical thinking in non-verbal children?

Design principles

The design principles reported in [Table 2](#) below are the results of the data synthesis following the ten-week study. Consistent with the four phases of DBR adopted for the current study ([Bakker 2018](#)), the following design principles were generated as a starting point towards nurturing CT in early-year classrooms.

Because oral stories can be adapted to fit the needs of different age groups and interests, this model has the potential to work across early years and primary school classrooms. Through professional development training in using this Storythinking programme educators can be supported to develop CT skills with the children in their classrooms.

Conclusions

This study confirms that timely, appropriate early childhood interventions for children developing as critical thinkers are essential. The Storythinking Programme proved effective as a means to create the strategies, time and space for both the educators and the children they work with to practice CT in a fun, imaginative, participatory way. Consistent with existing literature, children listened to different viewpoints ([Aras and Aslan 2018](#)), participated in high-cognitive demand questioning ([Cesur and Yaralı 2020](#)), and made logical inferences when the content was explicit ([Brocas and Carrillo 2020](#)). The strategies as a converged practice lead to emergent reasoning and problem-solving skills that, with practice, may become more complex over time ([Paul and Elder 2019](#)). In this study, CT skills developed and were sustained through the interactive pedagogical processes between children and educators. This supports the existing literature on the critical need to create classrooms that foster meaningful dialogue ([Mercer and Littleton 2007](#)). At the heart of this practice was the traditional art of oral storytelling. This

powerful tool provided the content from which children engaged with complex topics, thereby enhancing their CT skills. Moreover, embedding thinking time (Rowe 1986) and thinking language (Marić and Sakač 2018) into the Storythinking Programme added an extra strategy to further the scaffold CT.

Recommendations

Policy: Where settings are interested in conducting the Storythinking Programme, ECEC services should be provided with support in terms of training and resources. Training would be a short-term commitment, and resources would involve funding a trainer to deliver the intervention training.

Practice: In line with DBR, the Storythinking Programme facilitates continuous professional development for the educators who implement it. CT is challenging not only for children but also for adults. The programme encourages educators to engage with the children in developing CT as a community of learners.

Research: To understand how the Storythinking Programme may benefit children across different contexts, the evidence base for the current study needs to be conducted at a larger scale. The DBR study highlighted two areas worthy of future development.

- (1) How do we support children who do not verbally communicate to engage in critical?
- (2) How do we access emergent critical thinking in non-verbal children?

Disclosure statement

No potential conflict of interest was reported by the authors.

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Ethics approval and consent

Ethics approval is not required for the research presented here. Ethical approval for the original study was granted by Trinity College Dublin Ethics Board on December 17th 2020.

CRedit author statement

Catherine O'Reilly: Visualisation, Methodology Research, Conceptualisation, Writing – Original draft preparation, Reviewing and Editing, Final draft review and Editing.

Ann Devitt: Supervision, Methodology support, Validation, Editing.

Nóirín Hayes: Supervision, Conceptualisation support, Validation, Editing.

Breakdown of CRedit statement

The research team consist of Catherine O'Reilly, Ann Devitt and Nóirín Hayes.

Authors contributions to the published work:

The role of authors.

Catherine O'Reilly

- Primary PhD researcher
- Initial preparation, planning and writing
- Conduct extensive research using Trinity College Library resources
- Writing review and editing

Ann Devitt

- Expert adviser in the field of conducting a systematic literature review
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Appendix

The data in [Figure A1](#) documents group one’s reported incidences of critical thinking skills.

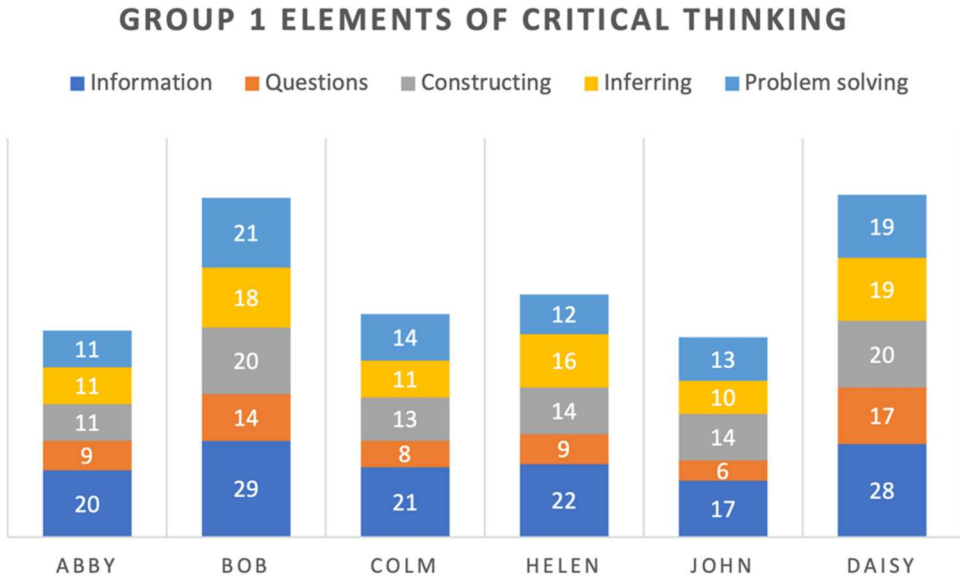


Figure A1. Group 1 Elements of critical thinking.

The data in [Figure A2](#) documents group two’s reported incidences of critical thinking skills.

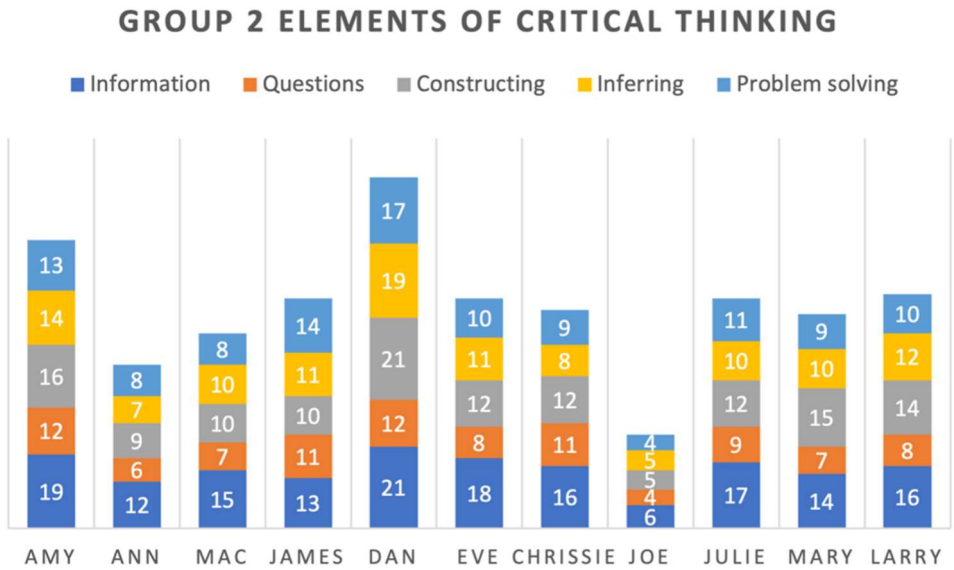


Figure A2. Group 2 Elements of critical thinking.