Coding Connections: Early Childhood Educators Guiding Computational Thinking with Robotic Play

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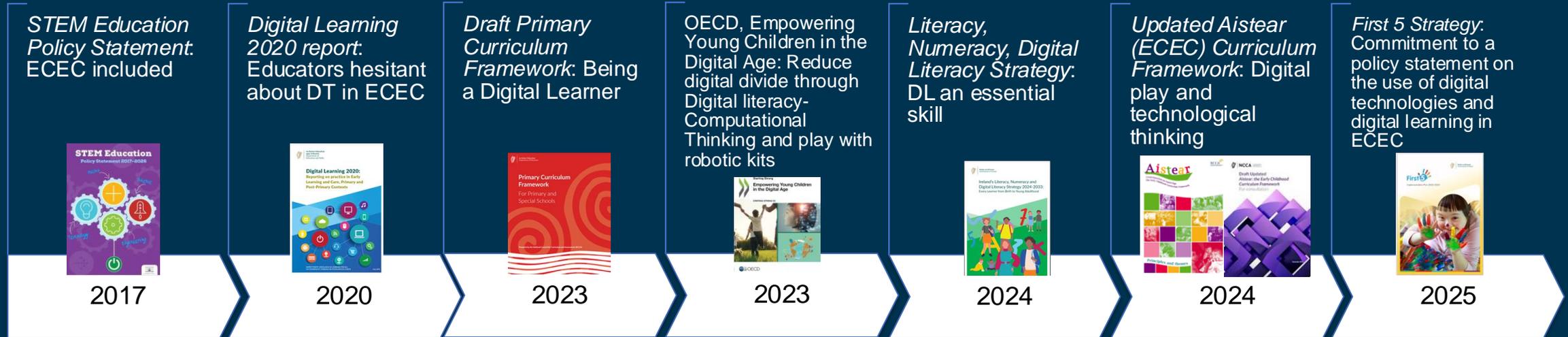NCI Research Day 2024
June 18th 2024

Research Overview

Supporting early childhood educators to:

- Design purposeful play with programmable robotics kits

- Support young children's development of computational thinking

Research Context

A shift from 'should' to 'how should' children engage with digital technologies in ECEC.

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STEM Education Policy Statement: ECEC included	*Digital Learning 2020 report*: Educators hesitant about DT in ECEC	*Draft Primary Curriculum Framework*: Being a Digital Learner	OECD, Empowering Young Children in the Digital Age: Reduce digital divide through Digital literacy-Computational Thinking and play with robotic kits	*Literacy, Numeracy, Digital Literacy Strategy*: DL an essential skill	*Updated Aistear (ECEC) Curriculum Framework*: Digital play and technological thinking	*First 5 Strategy*: Commitment to a policy statement on the use of digital technologies and digital learning in ECEC
2017	2020	2023	2023	2024	2024	2025

Research Gap:

• How to enact within ECEC curriculum

• How to support EC educators to make informed decisions

(DES, 2017; DES, 2020; NCCA, 2023; OECE, 2023; GoI, 2024; NCCA, 2009; 2023; GoI, 2025)

Computational Thinking

"Computational thinking involves **solving problems**, **designing systems**, and understanding human behavior by drawing on the concepts fundamental to computer science" (Wing, 2006, p.33)
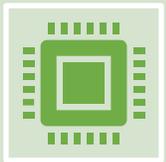
Computers have potential to be "carriers of powerful ideas and cultural change" (Papert, 1980, p. 4), bringing "new opportunities for children to understand, to love, and to use ideas that had previously been inaccessible to them" (Papert, 2000, p. 722).

CT in early childhood: "a type of analytical thinking" (Bers, 2010, p. 3) that "encompasses a broad range of **analytic and problem-solving skills**, **dispositions, habits**, and approaches used in computer science" (Pugnali, Sullivan and Bers, 2017, p.172).

Computational Thinking concepts 3–6-year-olds

🧠	Algorithmic thinking	Working out the steps needed to complete a task Arranging the steps in a logical sequence/ the coding cards in a logical sequence
👁	Pattern recognition	Spotting patterns from before that can be reused this time
🔍	Debugging	Finding and fixing mistakes and solving problems
📄	Decomposition	Breaking large tasks into smaller steps
▦	Abstraction	Reduce unnecessary detail- simplifying the process- easier to understand
⚙	Iteration	An iterative process to create the code and develop the programme

(based on Butler and Leahy, 2021; Bers, 2022)

Constructionist principles

'You can't think about thinking without thinking about thinking about something' (Papert)

Seymour Papert
(1928–2016)

🎓 Learning by doing

👥 Objects to think with

💡 Powerful ideas

💬 Self-reflection (thinking about thinking)

(Papert, 1980)

MINDSTORMS
CHILDREN, COMPUTERS, AND POWERFUL IDEAS
SEYMOUR PAPERT
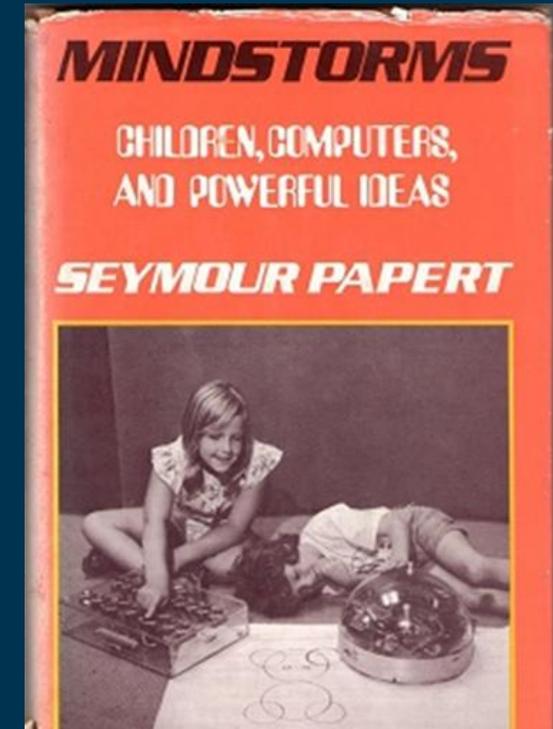
Objects to think with – programmable robotic kits

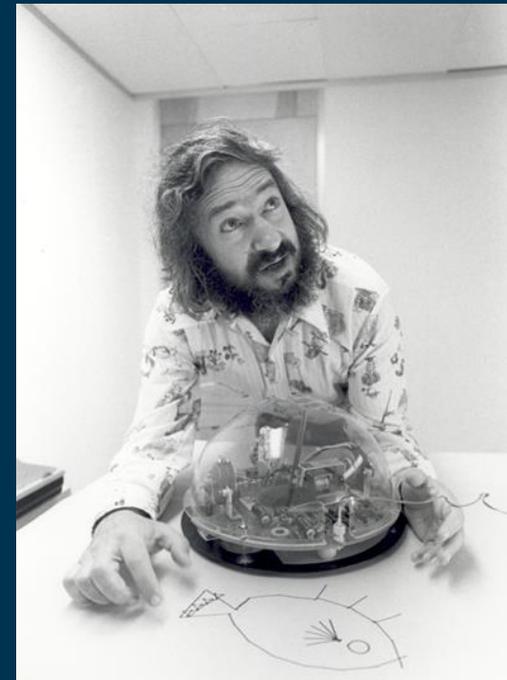Papert, The Logo Turtle (1969)

Low Floors (Easy to engage with)

Wide Walls (Facilitates choice and open-ended exploration)

High Ceilings (Facilitates deep exploration - offers challenge and complexity)

(Papert, 1980; Resnick, 2009)
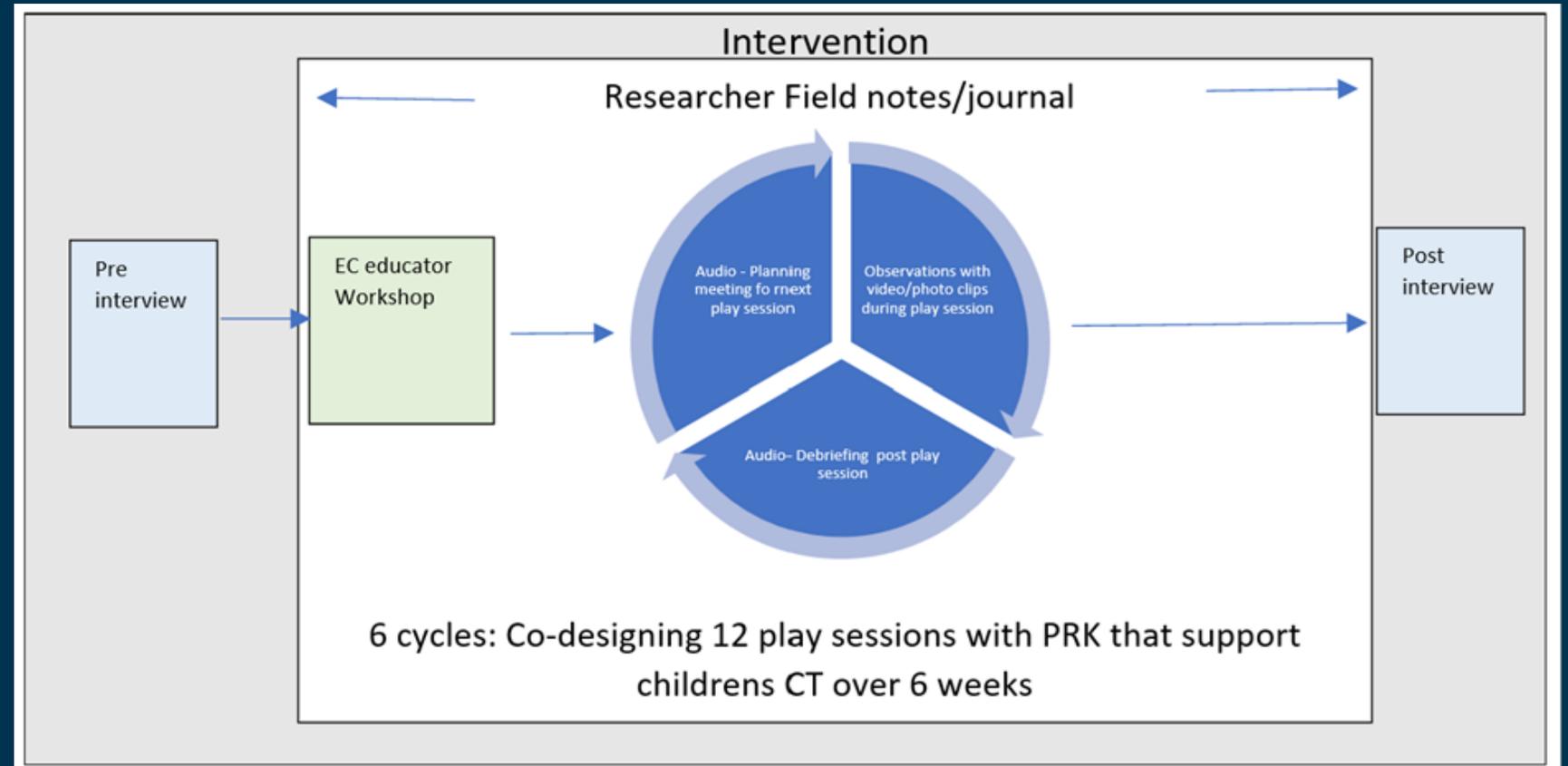

mTiny Programmable robotic kit

Research Question

What are the facilitating conditions that support early childhood educators to design learning experiences that develop young children's computational thinking through purposeful play with programmable robotics kits in an Irish ECEC context?

Intervention - Design-based research approach

- Co-design purposeful play with PRK with educators in one EC setting over 6 weeks

- Participatory:
  Researcher
  Educators (2)
  Children (10)

- Iterative process allows for changes to be made based on the children's engagement and the educators feedback.

- Multiple methods of data collection (Quals)

Intervention
Researcher Field notes/journal

Pre interview

EC educator Workshop

Audio - Planning meeting fo rnext play session

Observations with video/photo clips during play session

Audio- Debriefing post play session

Post interview

6 cycles: Co-designing 12 play sessions with PRK that support childrens CT over 6 weeks

Educators guiding computational thinking through purposeful play

Working out the steps needed to complete a task
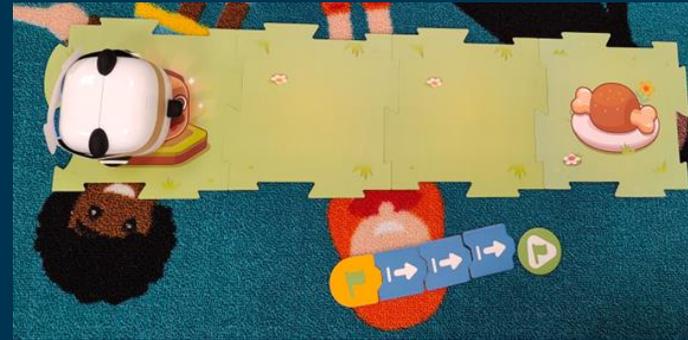
Programme sequence
How to get mTiny to draw a square
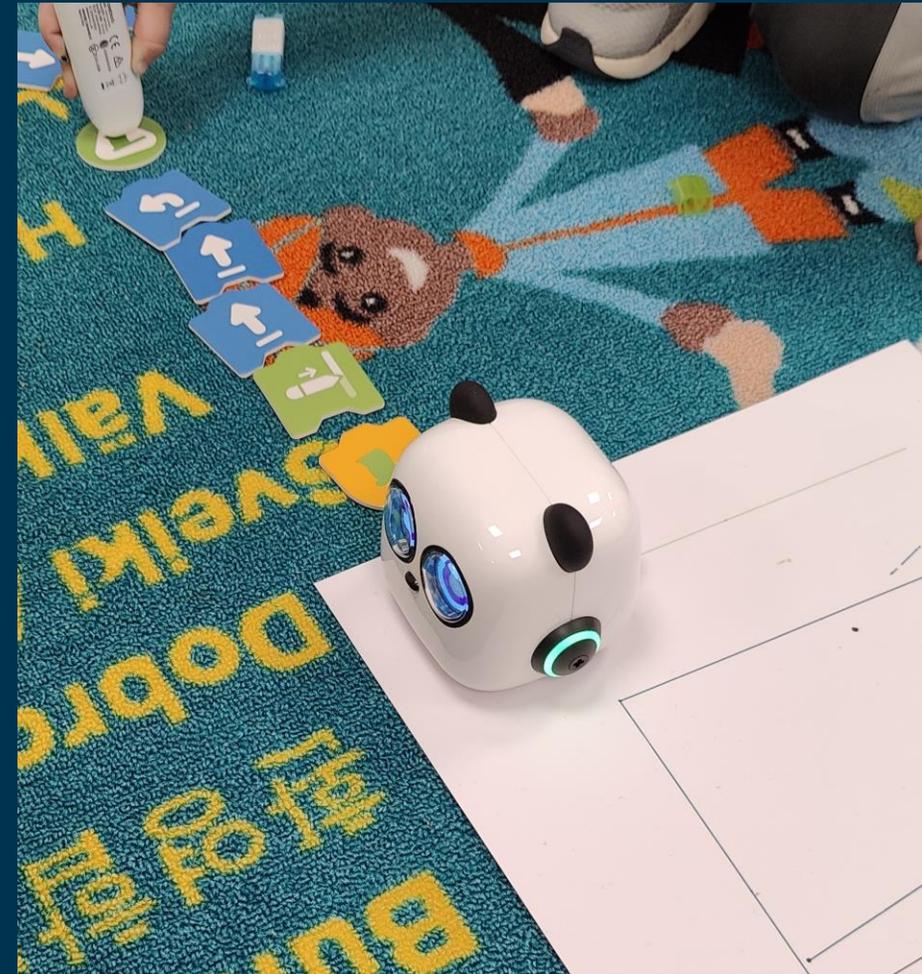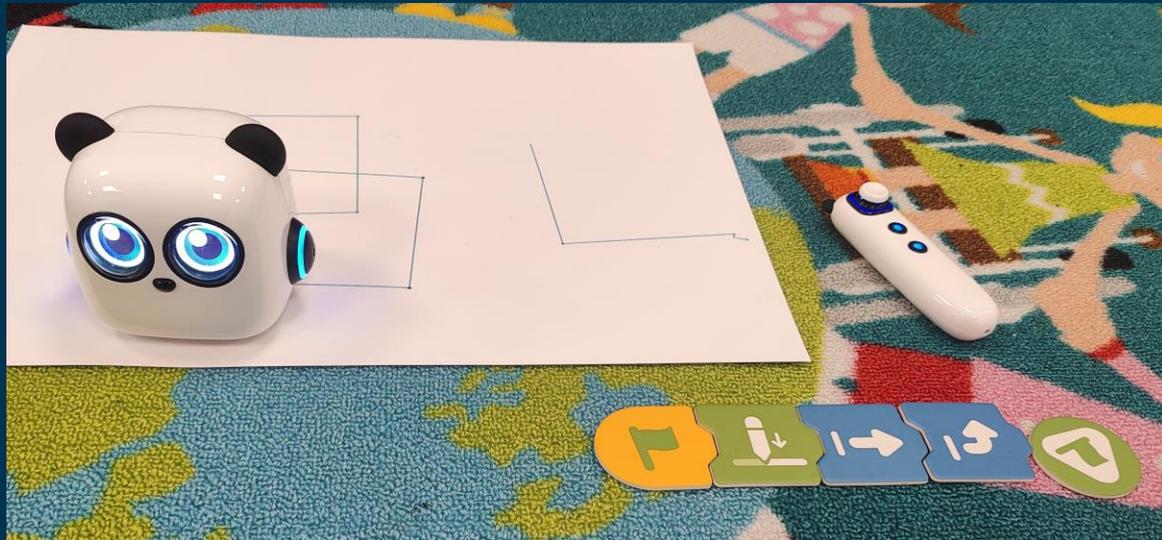
Thinking in sequences
creating meaningful stories

| Happy | Silly | Angry | Sad | Scared | Dizzy | Sleepy |

What Next

Analysis of the data-
Thematic Analysis

(Braun and Clarke, 2006; 2022)

Initial findings

New knowledge and practice; shift
in values, attitudes, beliefs.

Development of a
framework for educators
professional learning

Thank you

Any Questions

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Reference List

Bers et al (2022) The state of the field of computational thinking in early childhood education, OECD Education Working Papers No. 274, DOI: https://doi.org/10.1787/19939019, 52, pp 1060-1077

Braun, V. and Clarke, V. (2022) Thematic Analysis: A Practical Guide. 1st edition. London ; Thousand Oaks, California: SAGE Publications Ltd.

Butler, D. and Leahy, M. (2021) Developing preservice teachers' understanding of computational thinking: A constructionist approach, British Journal of Educational Technology, 52, pp 1060-1077

Department of Education and Skills. (2017) STEM Education Policy Statement 2017-2026 Available at: https://www.gov.ie/en/policy-information/4d40d5-stem-education-policy/

Department of Education and Skills. (2020) Digital Learning 2020: Reporting on practice in Early Learning and Care, Primary and Post-Primary Contexts. Available at: https://www.gov.ie/en/publication/c0053-digital-learning-2020-reporting-on-practice-in-early learning-and-care-primary-and-post-primary-contexts/ (Accessed 09/05/2021)..

Government of Ireland (GoI). (2023) First 5, Implementation Plan 2023-25 update. Available at: https://www.gov.ie/en/press-release/606d0-minister-ogorman-marks-world-childrens-day-with-new-first-5-implementation-plan/

Government of Ireland (GoI). (2024) Literacy, Numeracy and Digital Literacy Strategy , Available at: https://www.gov.ie/pdf/?file=https://assets.gov.ie/293255/a509a8d7-a4ac-43f9-acb0-29cdc26a1327.pdf#page=null (Accessed 10/6/24)

National Council for Curriculum and Assessment (NCCA), (2009) Aistear, Guidelines for Good Practice: Learning and developing through interactions, Dublin: Stationary Office.

National Council for Curriculum and Assessment. (2023a) Primary Curriculum Framework For Primary and Special Schools. Available at: https://curriculumonline.ie/getmedia/84747851-0581-431b-b4d7-dc6ee850883e/2023-Primary-Framework-ENG-screen.pdf (Accessed 28/4/2023).

National Council for Curriculum and Assessment. (2023b) Draft Update- Aistear: the Early Childhood Curriculum Framework. Available at: https://ncca.ie/media/6362/draftupdatedaistear_for-consultation.pdf (Accessed 14/9/2023).

OECD, (2023) Starting Strong: Empowering Young Children in the Digital Age, Available at: https://read.oecd-ilibrary.org/education/empowering-young-children-in-the-digital-age_50967622-en#page23 (Accessed 28/4/2023).

Papert, S. (1980) Mindstorms: Children, computers and powerful ideas, The Harvester Press, Brighton: UK

Papert, S. (2000) What's the big idea? Toward a pedagogy of idea power, IBM Systems Journal, 39 (3&4), pp. 720-729

Primo toys website: primotoys.com

Pugnali, A., Sullivan, A., and Bers, M.U. (2017) The impact of user interface on young children's computational thinking, Journal of Information Technology Education: Innovations in Practice. 16, PP. 171-193

Resnick, M. (2009). Kindergarten is the Model for Lifelong Learning. Edutopia.

Wing, J. M. (2006) Computational thinking. Communications of the ACM, 49(3), pp. 33–35. https://doi.org/10.1145/1118178.1118215.