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Planning, Development, and Research Stages



NGPM Materials Developed

- 8 Digital Games
- Non-digital classroom activities
- Teacher professional development
- Online Teacher Guide
- Subitizing & equipartitioning assessment

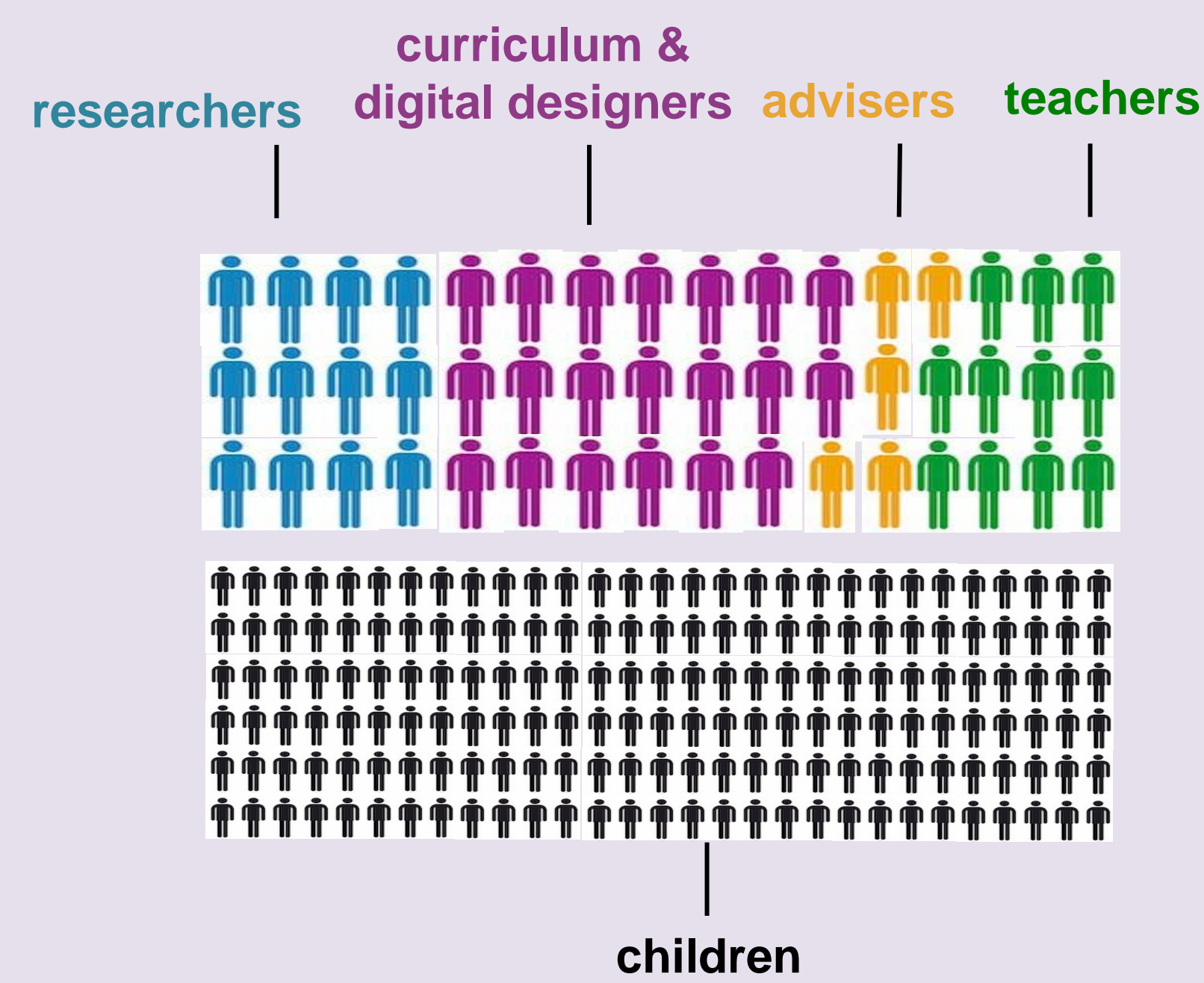
NGPM Boundary Object: The Learning Blueprint

Detailed learning goal (developmentally appropriate to already know or to learn the following)	Task (instructional or assessment)	Ways to vary difficulty	Possible scaffolding activities (if not successful in original activity)	Suggestions going forward
Identifying wholes as equipartitioned or not equipartitioned	Show a child portions of an object (e.g., pizza) ask them if each portion is an equal amount	"Complexibility of object (rectangles easier than circles) Varying number of receivers (easiest case is 2 receivers; then 2^n; then 2n and finally odds, starting with 3)"	Afterward: Promote overlays	"This could be built into the introduction (to be used as a training space) e.g., show how-to, have children decide whether next character carried it out correctly, then move into having the children do their own (next rows in this spreadsheet...) Or if children are not able to perform their own equipartitioning, have the identification as a lower level"

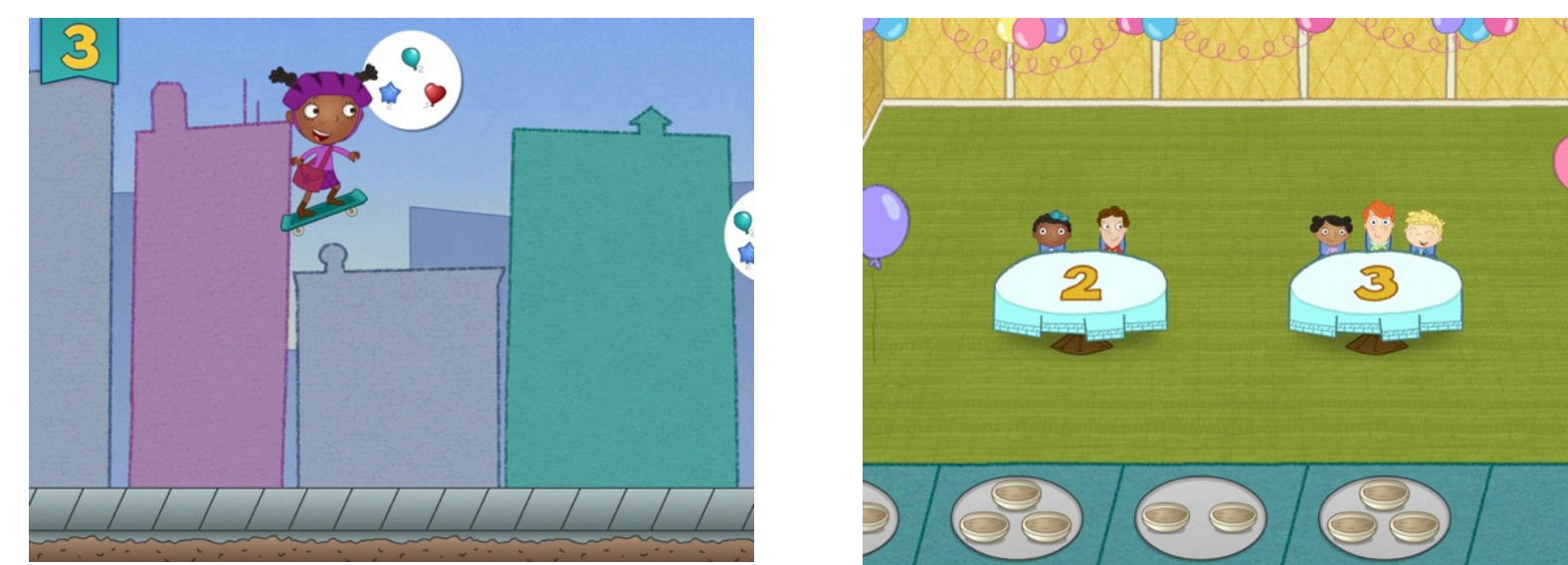
Project Goals

- Two projects – Next Generation Preschool Math (NGPM) and Science (NGPS) – seek to **promote early math and science learning** by:
- Supporting children's understanding of content,
 - Using interactive touch-screen tablets,
 - Integrating digital with non-digital activities (1:5 ratio);
 - Providing professional and technical support materials for preschool educators.

NGPM & NGPS Cross-Disciplinary Design Teams



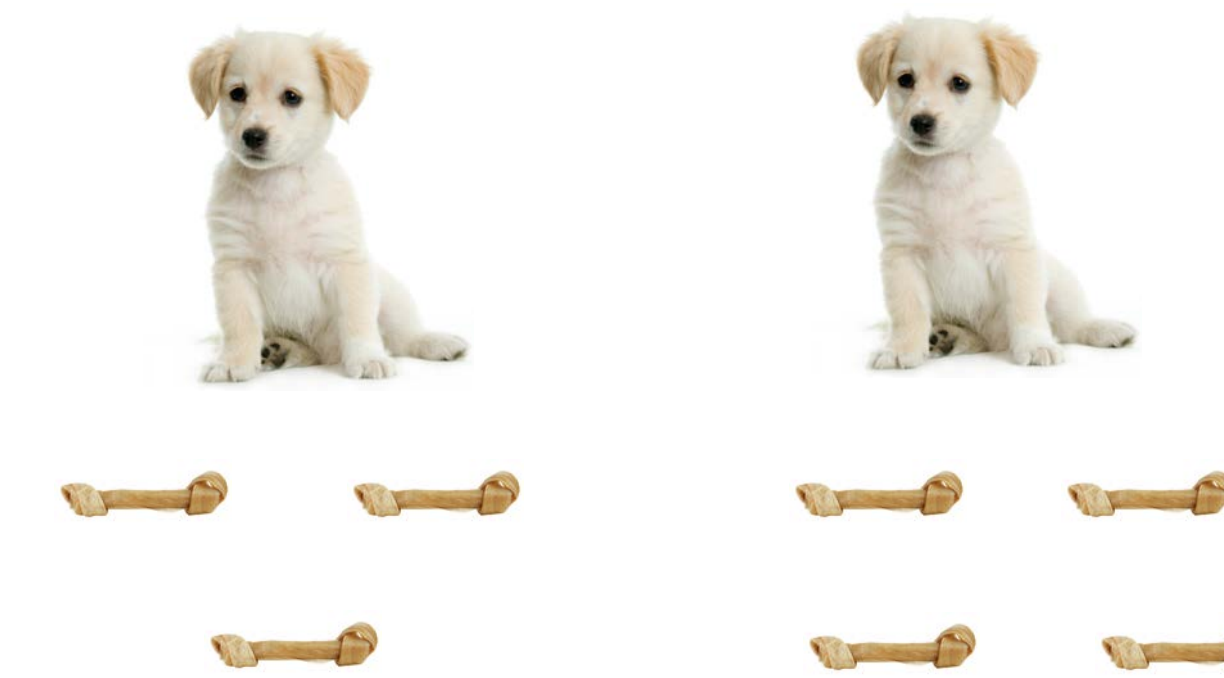
Sample Subitizing Games



Sample Equipartitioning Games



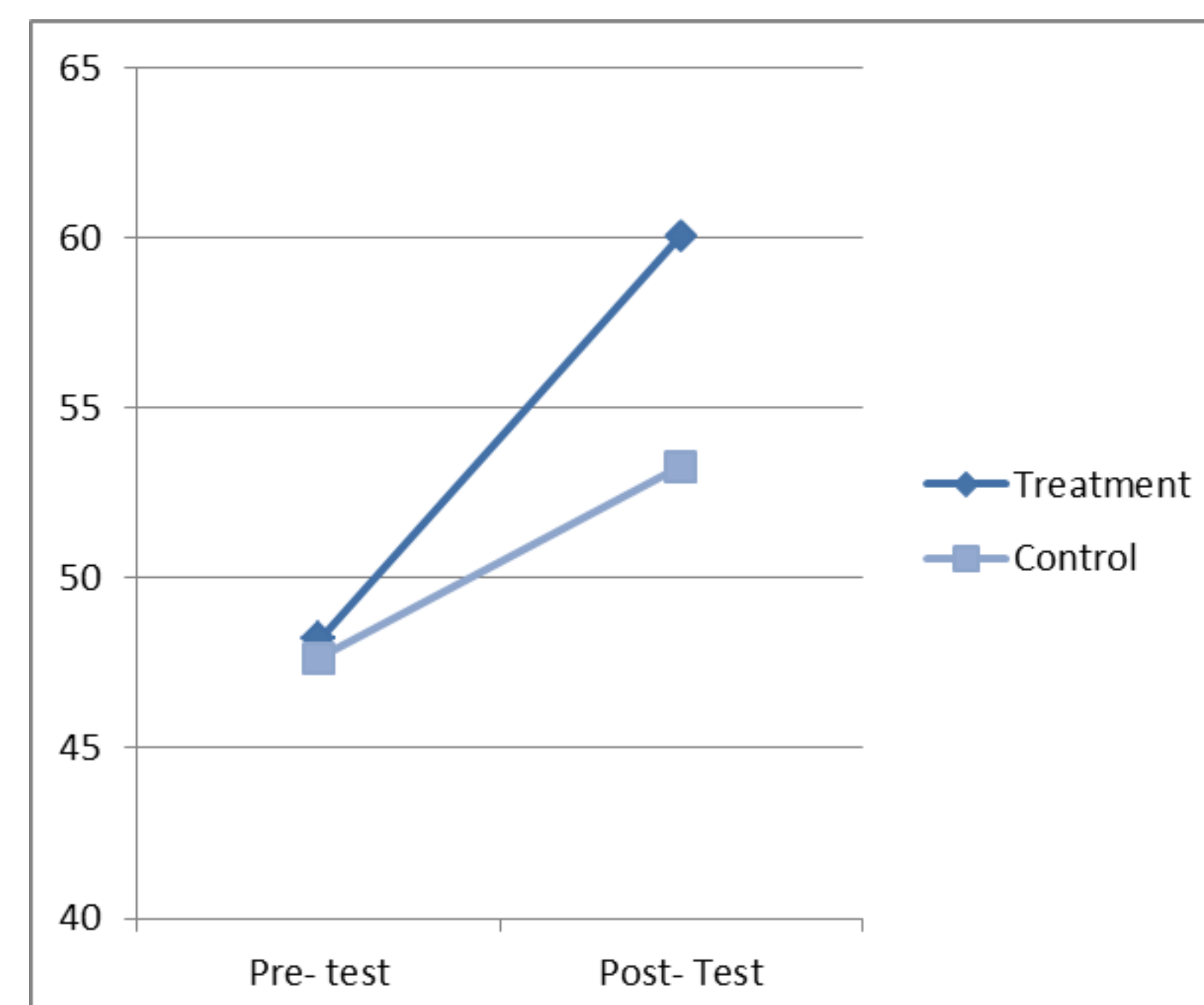
Sample Assessment Item: Equipartitioning



These are my two dogs; they each have some bones. (Tap the pictures of the two dogs and bones, left to right). Do the dogs each have the same number of bones? (Wait for child's response).

How do you know?

NGPM Pre- and Post- Assessment



NGPM Experimental Study

- Blocked, cluster-randomized trial; 16 preschool classrooms matched and randomized within each pair into condition: NGPM (n=8) or business-as-usual control group (n=8)
- Baseline equivalence on unit-specific and general math pre-test scores
- 2 level hierarchical linear model (HLM) analysis (students nested in classrooms)
- Statistically significant differences between experimental and control groups post-test scores on the unit-specific content (subitizing and equipartitioning) when classroom-level mean pretest scores were statistically controlled ($\alpha=.026$, effect size=.51)
- Results provide preliminary evidence that NGPM improves preschool children's understands of unit-specific content and adds credence to our approach of selectively integrating tablet-based games into the preschool learning environment.

NGPS Materials Currently Being Developed

- Classroom Toolkit to support inquiry/science practices
- Simulations and games to support learning of science concepts
- Non-digital activities and games
- Teacher professional development resources
- Online Teacher Guide
- Evidence centered design (ECD) science assessment

NGPS Framework

Development and Research anchored on *Learning Blueprint* that is based on research evidence and crosses content areas (physical, life and earth sciences) and practices (e.g., observing, predicting, etc.). Blueprint used to:

- Guide development of activities and resources (setting learning goals)
- Guide development of assessment (following ECD principles)

Researchers and Designers aim to develop activities and resources that:

- Respond to the needs of preschool classrooms (teachers and children) and can easily be integrated into existing curricular frameworks
- Are grounded on research (following learning goals from blueprint)
- Are developmentally appropriate (following NAEYC guidelines) and engaging
- Integrate media and technology into hands on activities activities to compliment learning that occurs during science investigation by capitalizing on the unique affordances of technology (e.g., ability to document via photos and videos, ability to simulate phenomena that are hard to observe repeatedly, opportunity for efficient repeated practice, etc.)
- Promote 1) understanding of science concepts, 2) engagement in science practices and 3) science talk

Researchers and Designers engage in *design-based research* in partnership with advisors and teachers and conduct implementation studies (including observations and feedback meetings) in classrooms where teachers pilot activities and provide feedback.

Assessment designers with early childhood and ECD expertise focused on:

- Identifying focal knowledge and skills,
- Identifying evidence that a child has mastered a learning goal, and
- Developing an assessment that can reliably differentiate between students who have and have not mastered the learning goals.

NGPM Cross-Disciplinary Design Perspectives

Curriculum designers and Researchers, focused on:

- Learning Trajectories Research
- Identifying and supporting key math concepts
- Repeated exposure to key math concepts
- Integrating student centered learning pedagogies
- Encouraging joint media engagement (child to teacher, child to child)
- Encouraging children and teachers to engage in rich math talk

Assessment designers, focused on:

- Identifying learning goals
- Identifying evidence that a child has mastered a learning goal
- Developing an assessment that can reliably differentiate between students who have and have not mastered the learning goals

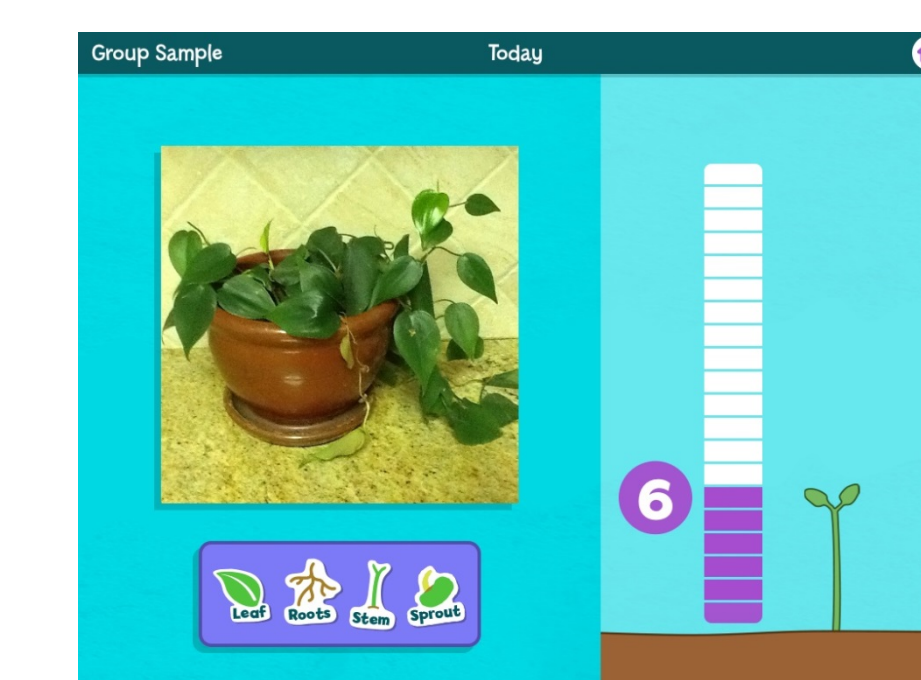
Media and technology designers, focused on:

- Affective engagement
- Time on task (that is enjoyable)
- Rich contexts for children's play
- Approachable and attractive characters
- Intuitive game mechanics that align with learning goals
- Tracking of student data to support teacher instruction

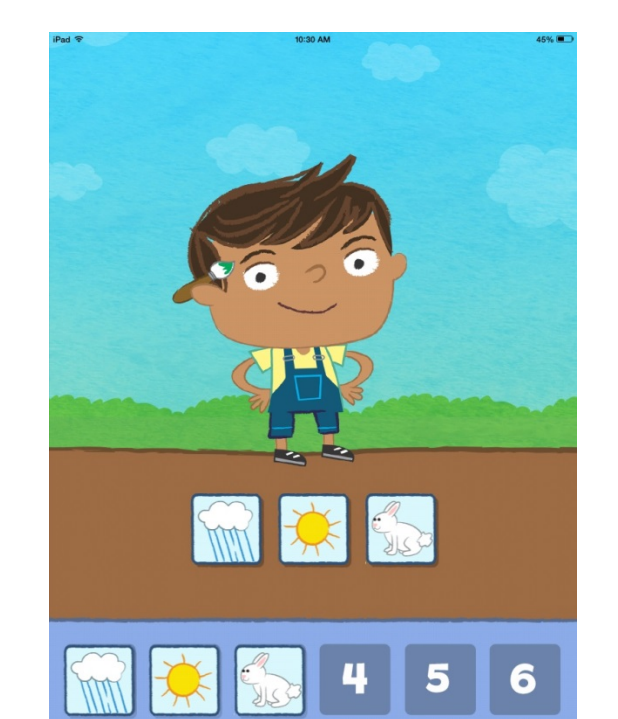
NGPM Pilot Implementation Findings

- The digital games resulted in child and teacher engagement with the math.
- Integration of tablet/technology "center" into preschool classroom was seamless.
- Teachers varied widely in how much they interjected into children's gameplay and provided scaffolding above and beyond that in the game.
- Teachers and children needed more explicit links between digital and non-digital activities.
- Games needed increased scaffolding and visually-based directions.
- Child learning of unit content improved and was statistically significant from pre- to post-testing.

Prototype Toolkit



Prototype Simulation



NGPS Emerging Pilot Implementation Findings

- Children were highly engaged while using many of the digital resources.
- Teachers were able to integrate most technologies into their teaching without difficulty.
- Digital resources worked best when teachers scaffolded their use and asked questions.
- Children demonstrated knowledge of most target learning goals.
- Children engaged in various science practices and science talk, but teachers would benefit from more training to support further learning in these areas.

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