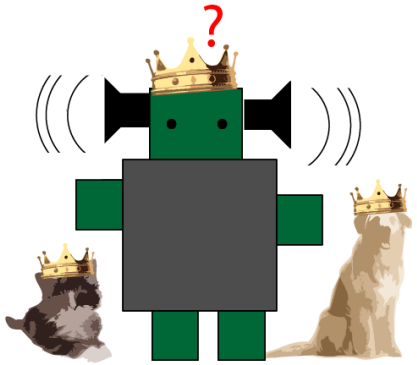


HCIM Capstone Project

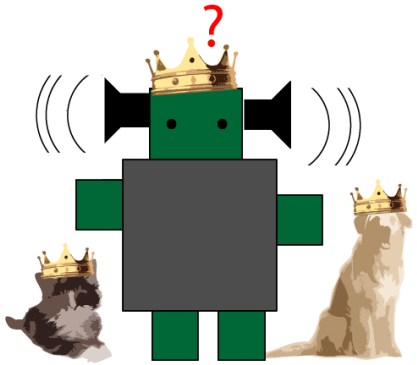
Pano Papadatos
Mona Leigh Guha
Tamara Clegg

Clinky the Robot:
Preliminary Programming for Preschoolers

HCIL HUMAN COMPUTER INTERACTION LABORATORY

UNIVERSITY OF 18 56 MARYLAND

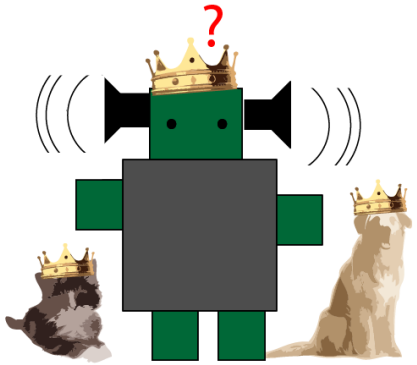
4/25/2013



Clinky the Robot

Problem

Young children lack exposure to programming



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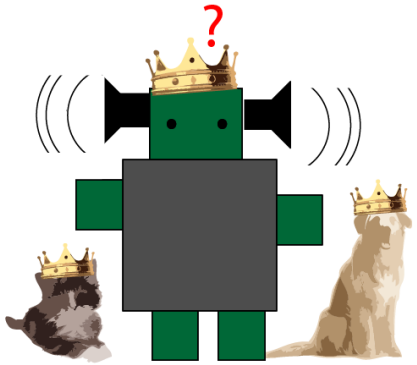
Why is that a problem? (Motivation)

Harnessing the full potential of computers[1]

Debugging skills are beneficial to everyone[2, 3, 4]

Computer Science: Not the most diverse field[5, 6]

[1] D. C. Smith, A. Cypher and L. Tesler, "Programming by example: novice programming comes of age," Communications of the ACM, vol. 43, no. 3, pp. 75-81, 2000.
[2] A. Sipitakiat and N. Nusen, "Robo-Blocks: designing debugging abilities in a tangible programming system for early primary school children," in *Proceedings of IDC 12*, Bremen, Germany, 2012.
[3] L. Morgado, M. Cruz and K. Kahn, "Preschool Cookbook of Computer Programming Topics," *Australasian Journal of Educational Technology,* vol. 26, no. 3, 2010.
[4] P. Wyeth, "How Young Children Learn to Program with Sensor, Action, and Logic Blocks," *Journal of the Learning Sciences,* vol. 17, no. 4, pp. 517-550, 2008.
[5] A. Fisher and J. Margolis, "Unlocking the clubhouse: the Carnegie Mellon experience," *ACM SIGCSE Bulletin,* vol. 34, no. 2, pp. 79-83, 2002.
[6] A. Fisher and J. Margolis, "Unlocking the clubhouse: women in computing," in *Proceedings of SIGCSE 03*, Reno, NV, USA, 2003.



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Can they do it?

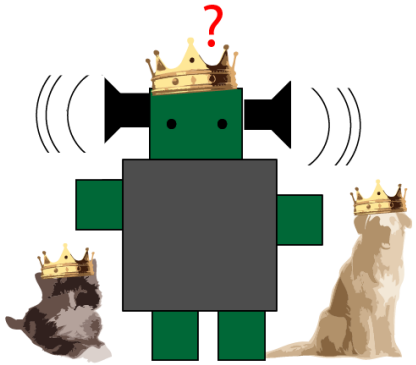
Comfortable with computers[1]

Independent in their exploration processes[2]

Developmentally Appropriate[3]

Children want to program[4]

[1] L. Morgado, M. Cruz and K. Kahn, "Preschool Cookbook of Computer Programming Topics," *Australasian Journal of Educational Technology,* vol. 26, no. 3, 2010.
[2] J. Montemayor, *Physical programming: tools for kindergarten children to author physical interactive environments,* University of Maryland, College Park, MD, USA: Thesis, 2003.
[3] Wyeth, "How Young Children Learn to Program with Sensor, Action, and Logic Blocks," Journal of the Learning Sciences, vol. 17, no. 4, pp. 517-550, 2008.
[4] M. Kindborg and P. Sökjer, "How preschool children used a behaviour-based programming tool," in *Proceedings of IDC 07*, Aalborg, Denmark, 2007.



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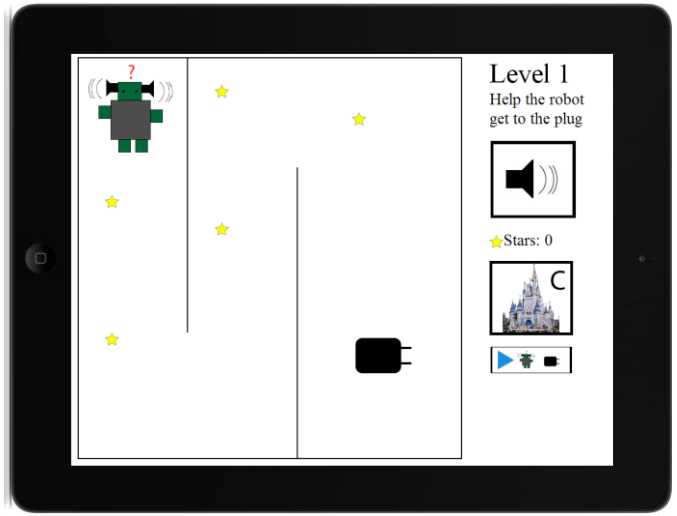
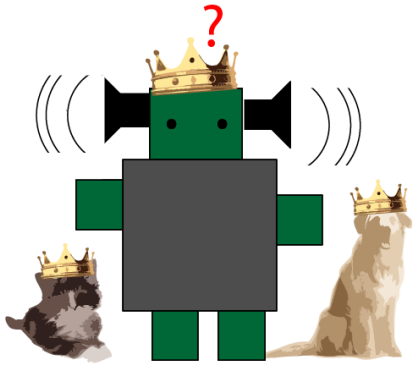
Solution (Product)

iPad application to help young children (3-5) develop programming skills



Touch screens

Easy to use – Soon in classrooms – Easily available



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Related Work

Product-focused (>5 years old)

Logo & sons, Scratch, Toontalk, Alice, Move the Turtle

Research-focused

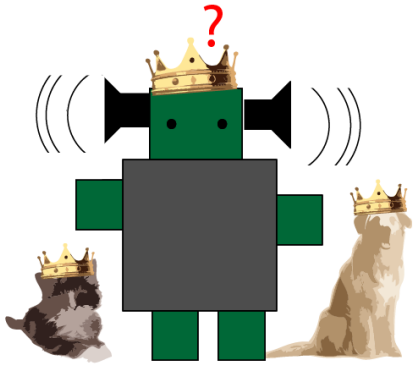
Kahn & Morgado (Cookbook: 3-5)

McKnight & Fitton (Touch Screens)

Lin & Liu (Child-adult Collaboration)

Limitation of the field

The bulk of the research is for older children and not on touch screens



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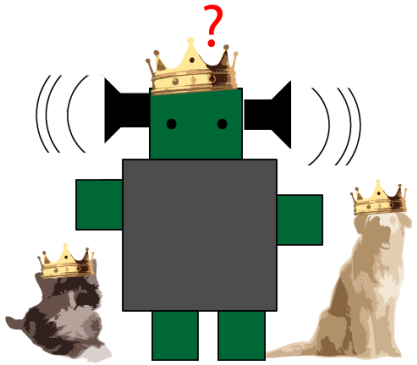
Related Concepts

Morgado and Cruz
Syntax and Semantics, Compound Procedures, Parameter Passing, Parallel Execution

Wyeth:

- Syntax and functionality
- Specific Outcomes
- Reusing parts
- Debugging
- Planning
- Alternative solutions

Barr and Stephenson: Computational Thinking skills



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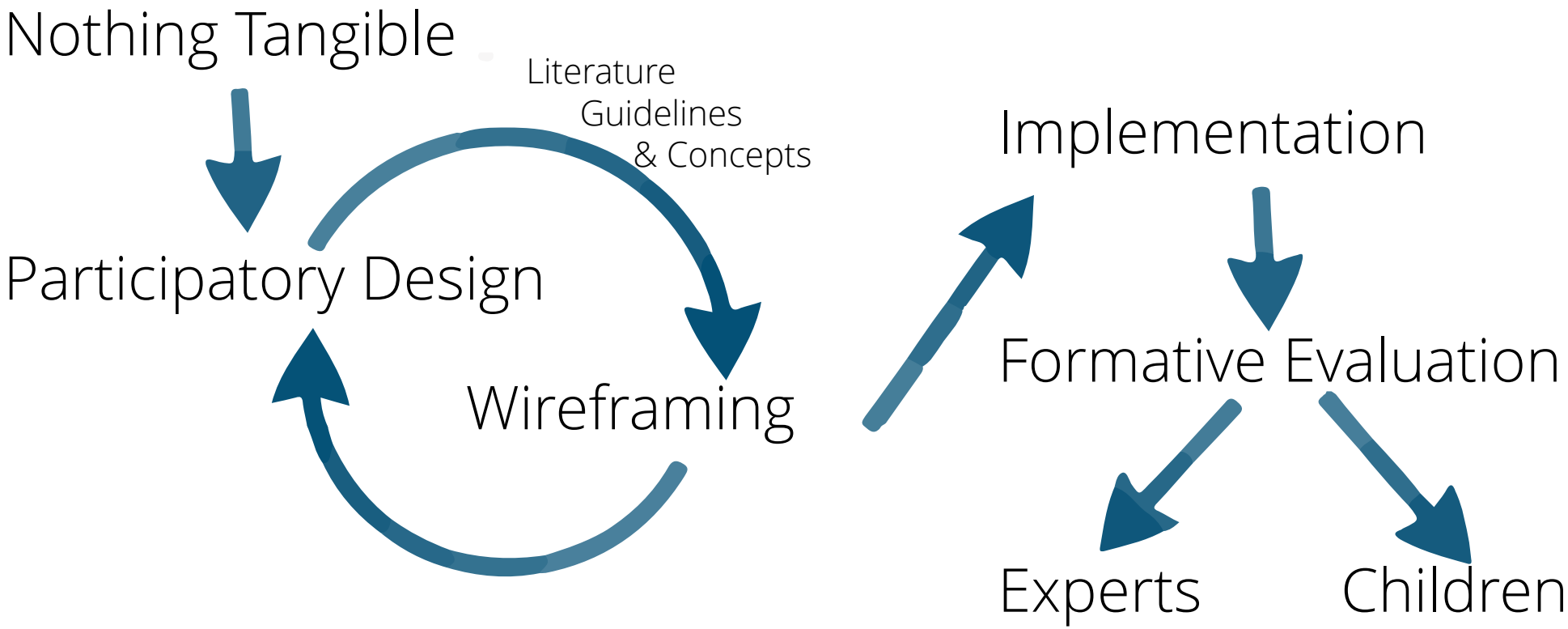
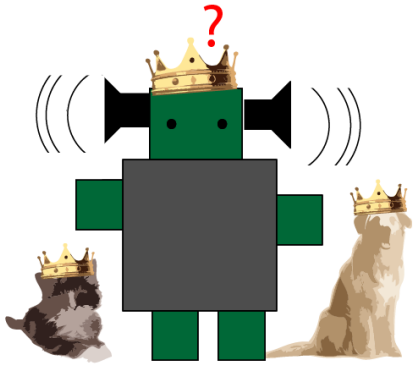
Design Approach

Cooperative Inquiry Techniques





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Kidsteam

Children-Adult Design Partnership
7 Adults, 8 Children, ages 7-11

Session 1: Robot activity and drawing (1h)

Goal: Initial Wireframe, Lots of ideas

Analysis: Big ideas, Debriefing, Observing themes

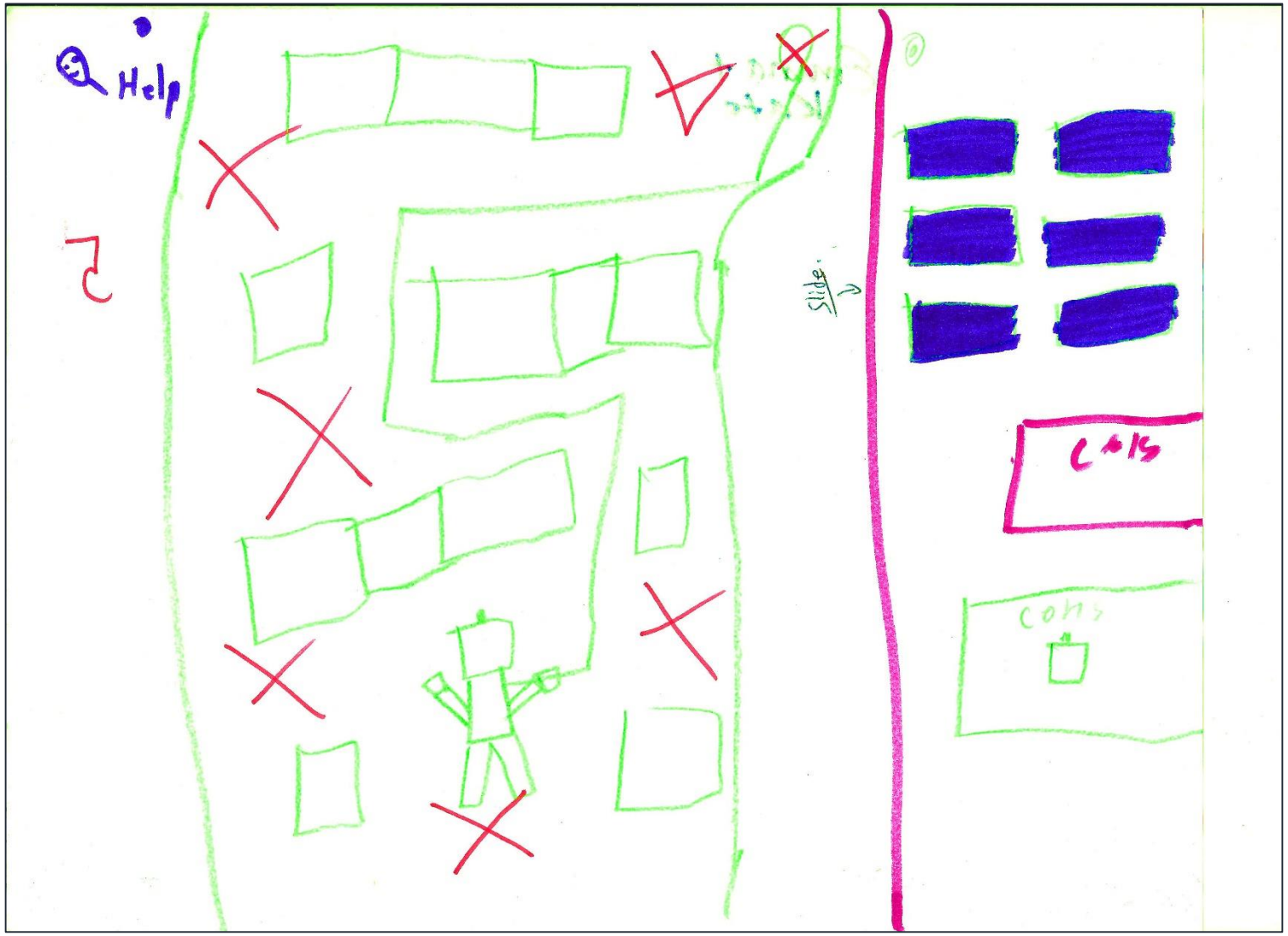
Results: Game

Separate levels

Robots & Castles

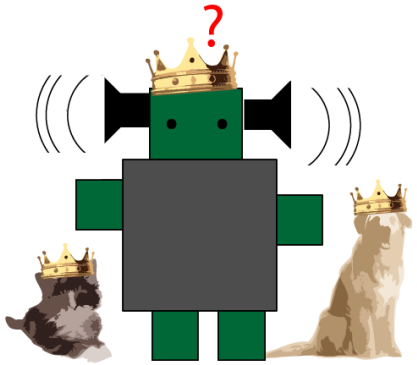
Customizability & Upgrades

Collecting Items



Drawing of the Application (Session 1)

Circle Time!



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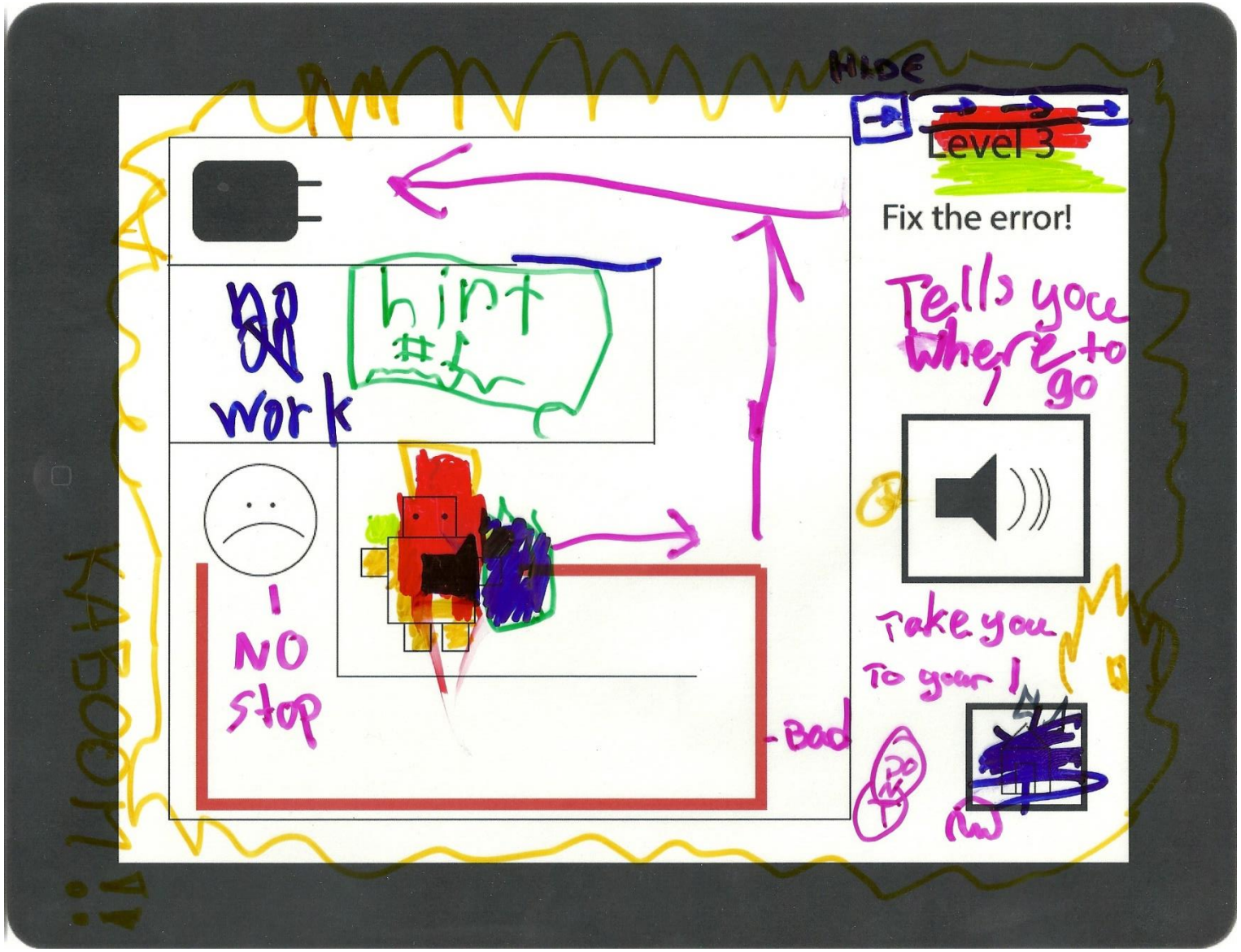
Kidsteam – Layered Elaboration

Session 2: Rapid Iterations & Rotations (1h)

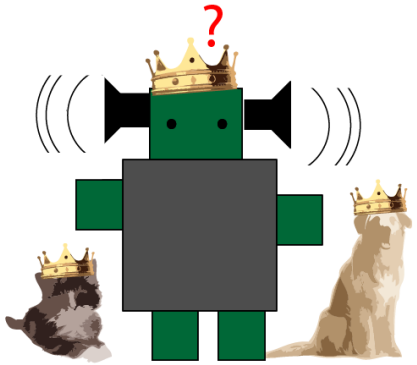
Goal: Brainstorm and build on the wireframe

Analysis: Themes – Notes & Designs

Results: Animals
Personal Experience
Positive Feedback
Currency
Surprises



Layered Elaboration design



Clinky the Robot

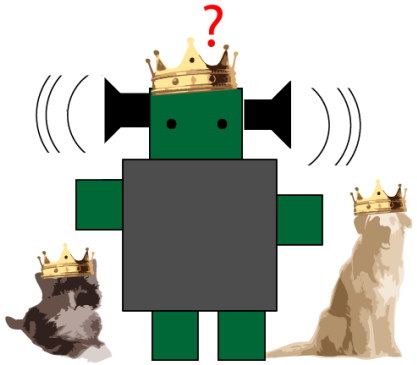
Prototype (Demo)

5 levels

Robot & Castle

Stars as Currency

Upgrades



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Formative Evaluation - Experts

Sessions 3 & 4: Interviews - Teachers of 3 & 4, 5 (20m)

Goal: Quality of interactions & learning

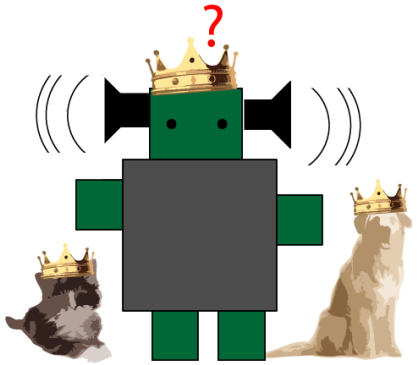
Results: Age Appropriate (almost)

Repeating

Practical Guidelines

>Touch interactions, Instructions

Guided VS Independent



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Formative Evaluation - Children

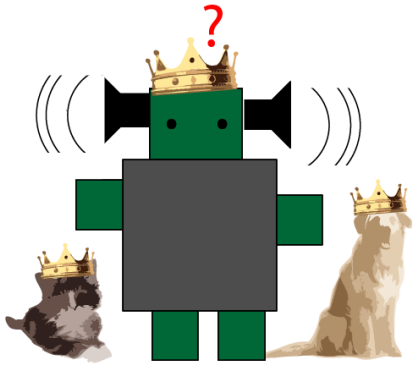
Sessions 5, 6 & 8: (20m)

6 Children in pairs of two (3 & 5, 4 & 4, 4 & 4)

Goal: Formative evaluation (Usability & Challenges)

Results: What the teachers said

5/5! ☺	Expectations
Level 4	Castle and stars
Drawing	Replaying



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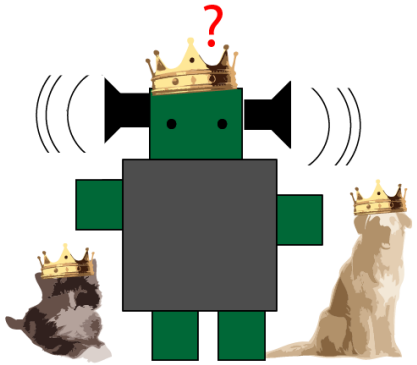
Limitations

Not final

Evaluating learning outcomes

Not enough levels

Structuring the learning



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Future Work

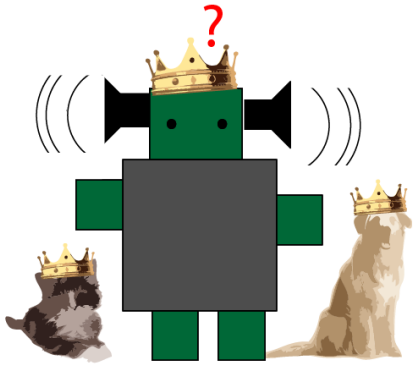
Designing for 3, 4, 5 and 5+

Implementing Repetition

How do concepts evolve over time

Designing for independent VS guided

Improving Usability (instructions and interactions)



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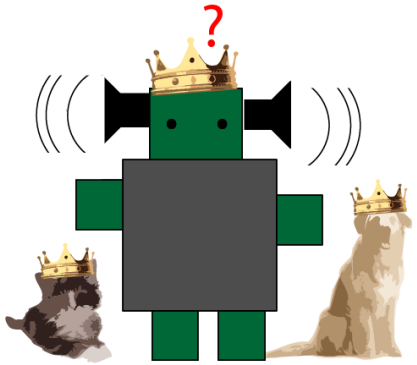
Discussion

Children enjoy programming-like activities:
they can enrich the field of Computer Science

How do we integrate this in preschool education?

How do we scaffold the transition?

How do we design a guided activity?



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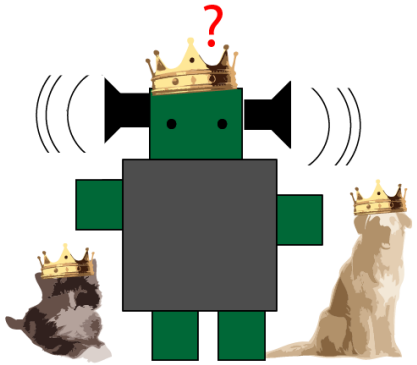
Conclusion

The children liked it!

They wanted to play it again

The process of helping them learn is complicated

Children change a lot between 3 and 5



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Acknowledgements

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HCIL