# Learning, Education, and Families

## Overview

Sarah Nassery, Jamie Lee, Seungmin Jeong

# Table of contents

# CHI subcommittee





**Specific Applications Areas**

**Learning, Education, and Families became its own subcommittee**

- **Example user groups:**
  children, families, people in developing countries, employees, charities and third sector organisations
- **Example application areas:**
  education, home, sustainability, ICT4D, creativity

# Goal: Tech for Children

**RQ:**
How do children, parents, and families interact with technology?

**Family**

**Learning & Edu**

**RQ:**
How to design, build, and deploy technologies for learning processes and in educational settings?

@ Primary, Secondary, and Higher Education
@ Homes, Museums, Libraries, After-school settings
@ Online learning
➕Learning at scale

# Topics

- Health & Well-being
- Social, Psychological, and Cultural Phenomena
- (Parents' involvement in their children's behavioral intervention)

**Family**

**Learning & Edu**

**Screen Time Tantrums: How Families Manage Screen Media Experiences for Toddlers and Preschoolers**

**Alexis Hiniker, Hyewon Suh, Sabina Cao, Julie A. Kientz**
Human Centered Design and Engineering, University of Washington
Seattle, WA, USA
{alexisr, hyewon25, sabinac, jkientz}@uw.edu

- Systems for collaborative learning and social discussion
- Multimedia interfaces for learning
- Technology-supported learning
- Tangible learning interfaces
- Intelligent tutoring systems
- Learning analytics
- Teacher/educator-facing designs

# Match Topic!

- Systems for collaborative learning and social discussion
- Multimedia interfaces for learning
- Technology-supported learning
- Tangible learning interfaces.
- Intelligent tutoring systems
- Learning analytics
- Teacher/educator-facing designs

CHI 2024
Surfing the World

## Science Everywhere: Designing Public, Tangible Displays to Connect Youth Learning Across Settings

**June Ahn[1], Tamara Clegg[2], Jason Yip[3], Elizabeth Bonsignore[2], Daniel Pauw[2], Lautaro Cabrera[2], Kenna Hernly[2], Caroline Pitt[3], Kelly Mills[2], Arturo Salazar[3], Diana Griffing[3], Jeff Rick, & Rachael Marr[2]**
New York University[1], University of Maryland-College Park[2], University of Washington-Seattle[3]
june.ahn@nyu.edu; {tclegg, ebonsign, dpauw, cabrera1, kenna}@umd.edu;
{jcyip, pittc, salaza3, griff16}@uw.edu

**Figure 1. *Science Everywhere* (SE) is a sociotechnical system designed to facilitate learning across neighborhood settings. Children use the SE social media app to share the science they notice in their everyday lives. Public, interactive displays placed in locations across the neighborhood facilitate awareness of children's thinking in order to coordinate support for their learning across settings.**

**Which topic?**

## Juxtapeer: Comparative Peer Review Yields Higher Quality Feedback and Promotes Deeper Reflection

**Julia Cambre[1,2], Scott Klemmer[1], Chinmay Kulkarni[2]**
[1]UC San Diego, [2]Carnegie Mellon University
{jcambre, chinmayk}@cs.cmu.edu, srk@ucsd.edu

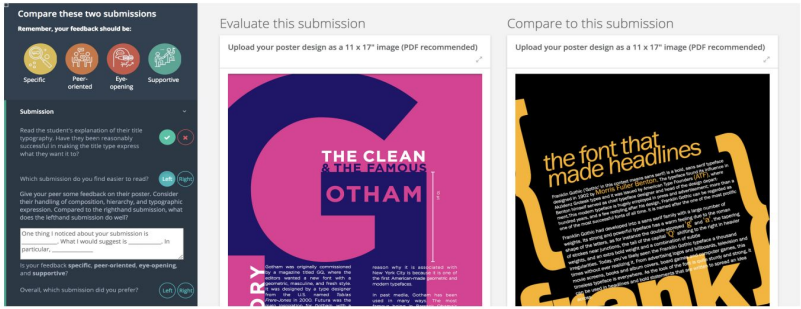



**Figure 1. The review interface presents two peer submissions side-by-side, and aligns corresponding submission parts so reviewers can identify similarities and differences. To scaffold feedback, a rubric guides the reviewer through a structured comparison.**

**Which topic?**

# Match Topic!

- Systems for collaborative learning and social discussion
- Multimedia interfaces for learning
- Technology-supported learning
- Tangible learning interfaces.
- Intelligent tutoring systems
- Learning analytics
- Teacher/educator-facing designs

CHI 2024
Surfing the World

## Science Everywhere: Designing Public, Tangible Displays to Connect Youth Learning Across Settings

**June Ahn[1], Tamara Clegg[2], Jason Yip[3], Elizabeth Bonsignore[2], Daniel Pauw[2], Lautaro Cabrera[2], Kenna Hernly[2], Caroline Pitt[3], Kelly Mills[2], Arturo Salazar[3], Diana Griffing[3], Jeff Rick, & Rachael Marr[2]**
New York University[1], University of Maryland-College Park[2], University of Washington-Seattle[3]
june.ahn@nyu.edu; {tclegg, ebonsign, dpauw, cabrera1, kenna}@umd.edu;
{jcyip, pittc, salaza3, griff16}@uw.edu

**Figure 1. *Science Everywhere* (SE) is a sociotechnical system designed to facilitate learning across neighborhood settings. Children use the SE social media app to share the science they notice in their everyday lives. Public, interactive displays placed in locations across the neighborhood facilitate awareness of children's thinking in order to coordinate support for their learning across settings.**

**Multimedia interfaces for learning**
**Tangible learning interfaces**

## Juxtapeer: Comparative Peer Review Yields Higher Quality Feedback and Promotes Deeper Reflection

**Julia Cambre[1,2], Scott Klemmer[1], Chinmay Kulkarni[2]**
[1]UC San Diego, [2]Carnegie Mellon University
{jcambre, chinmayk}@cs.cmu.edu, srk@ucsd.edu

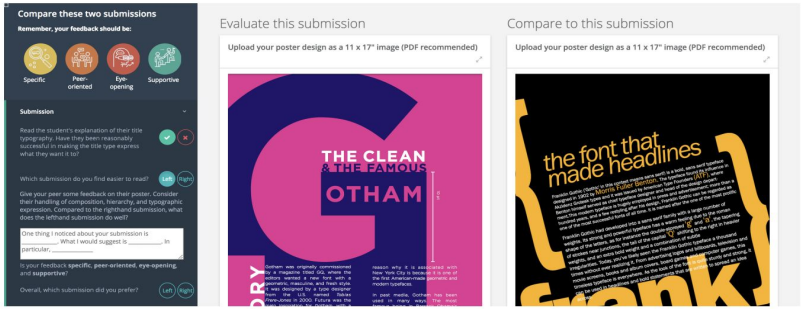



**Figure 1. The review interface presents two peer submissions side-by-side, and aligns corresponding submission parts so reviewers can identify similarities and differences. To scaffold feedback, a rubric guides the reviewer through a structured comparison.**

**Systems for collaborative learning and social discussion**

# Match Topic!

- Systems for collaborative learning and social discussion
- Multimedia interfaces for learning
- Technology-supported learning
- Tangible learning interfaces.
- Intelligent tutoring systems
- Learning analytics
- Teacher/educator-facing designs

CHI 2024
Surfing the World

## MapSense: Multi-Sensory Interactive Maps for Children Living with Visual Impairments


**Emeline Brule**[2,3,4] **Gilles Bailly**[1,2,3,4] **Anke Brock**[5]

**Frédéric Valentin**[2,3,4] **Grégoire Denis**[6] **Christophe Jouffrais**[2,7]

[1] LTCI, [2] CNRS, [3] Telecom ParisTech, [4] Paris-Saclay University
[5] INRIA Bordeaux, [6] IJA Toulouse, [7] University of Toulouse

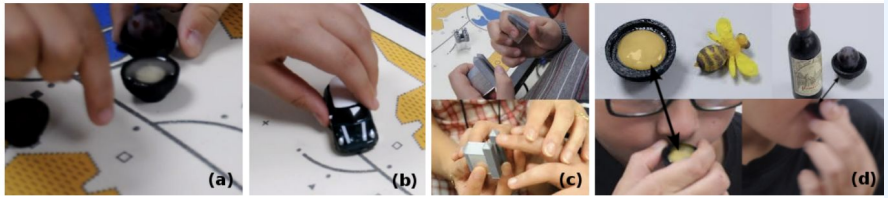




**Figure 1: (a) Children collaborating using multi-sensory tangibles, (b) child exploring the map using a figurative tangible, (c) Children during tactile discovery of figurative tangibles, (d) examples of multi-sensory tangibles, which can be tasted or scented.**

**Which topic?**

## ThinkActive: Designing for Pseudonymous Activity Tracking in the Classroom


**Andrew Garbett, David Chatting, Gerard Wilkinson, Clement Lee, Ahmed Kharrufa**
Open Lab, Newcastle University,
Newcastle upon Tyne, UK,
{andy.garbett, david.chatting, g.wilkinson, clement.lee, ahmed.kharrufa}@newcastle.ac.uk


The system encourage primary aged school children to reflect on their own personal activity data in the classroom. (...) The system utilizes inexpensive activity trackers and pseudonymous avatars to promote reflection with personal data using an in-situ display within the classroom.

## Teaching Language and Culture with a Virtual Reality Game


**Alan Cheng**[1], **Lei Yang**[2], **and Erik Andersen**[1]
[1]Department of Computer Science, [2]Department of City and Regional Planning, Cornell University
{ayc48, ly292, ela63}@cornell.edu


**Which topic?**

# Match Topic!

- Systems for collaborative learning and social discussion
- Multimedia interfaces for learning
- Technology-supported learning
- Tangible learning interfaces.
- Intelligent tutoring systems
- Learning analytics
- Teacher/educator-facing designs

CHI 2024
Surfing the World

## MapSense: Multi-Sensory Interactive Maps for Children Living with Visual Impairments


**Emeline Brule**[2,3,4] **Gilles Bailly**[1,2,3,4] **Anke Brock**[5]

**Frédéric Valentin**[2,3,4] **Grégoire Denis**[6] **Christophe Jouffrais**[2,7]

[1] LTCI, [2] CNRS, [3] Telecom ParisTech, [4] Paris-Saclay University
[5] INRIA Bordeaux, [6] IJA Toulouse, [7] University of Toulouse

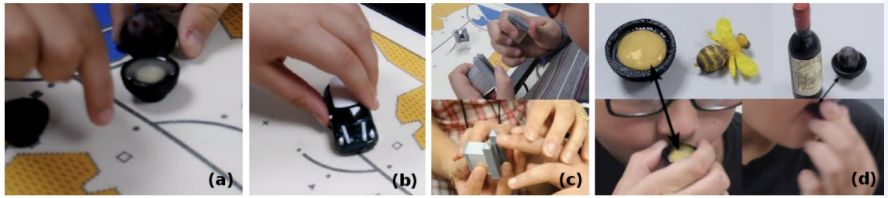




**Figure 1: (a) Children collaborating using multi-sensory tangibles, (b) child exploring the map using a figurative tangible, (c) Children during tactile discovery of figurative tangibles, (d) examples of multi-sensory tangibles, which can be tasted or scented.**

**Technology-supported learning**
**Tangible learning interfaces**

## ThinkActive: Designing for Pseudonymous Activity Tracking in the Classroom


**Andrew Garbett, David Chatting, Gerard Wilkinson, Clement Lee, Ahmed Kharrufa**
Open Lab, Newcastle University,
Newcastle upon Tyne, UK,
{andy.garbett, david.chatting, g.wilkinson, clement.lee, ahmed.kharrufa}@newcastle.ac.uk


The system encourage primary aged school children to reflect on their own personal activity data in the classroom. (...) The system utilizes inexpensive activity trackers and pseudonymous avatars to promote reflection with personal data using an in-situ display within the classroom.

## Teaching Language and Culture with a Virtual Reality Game


**Alan Cheng**[1], **Lei Yang**[2], **and Erik Andersen**[1]
[1]Department of Computer Science, [2]Department of City and Regional Planning, Cornell University
{ayc48, ly292, ela63}@cornell.edu


**Technology-supported learning**

# Match Topic!

- Systems for collaborative learning and social discussion
- Multimedia interfaces for learning
- Technology-supported learning
- Tangible learning interfaces.
- Intelligent tutoring systems
- Learning analytics
- Teacher/educator-facing designs

CHI 2024
Surfing the World

**OATutor: An Open-source Adaptive Tutoring System and Curated Content Library for Learning Sciences Research**


Zachary A. Pardos
UC Berkeley School of Education
Berkeley, CA, USA
pardos@berkeley.edu

Matthew Tang*
UC Berkeley EECS
Berkeley, CA, USA
matthewtang@berkeley.edu

Ioannis Anastasopoulos*
UC Berkeley School of Education
Berkeley, CA, USA
ioannisa@berkeley.edu

Shreya K. Sheel*
UC Berkeley School of Education
Berkeley, CA, USA
shreya_sheel@berkeley.edu

Ethan Zhang
UC Berkeley EECS
Berkeley, CA, USA
ethanzhang@berkeley.edu


**Which topic?**

**Motivation as a Lens to Understand Online Learners: Toward Data-Driven Design with the OLEI Scale**


RENÉ F. KIZILCEC and EMILY SCHNEIDER, Stanford University


**Which topic?**

**Unobtrusively Enhancing Reflection-in-Action of Teachers through Spatially Distributed Ambient Information**


Pengcheng An[1] Saskia Bakker[1] Sara Ordanovski[3] Ruurd Taconis[2] Chris L.E. Paffen[3] Berry Eggen[1]
[1]Department of Industrial Design, Eindhoven University of Technology, the Netherlands
[2]Eindhoven School of Education, Eindhoven University of Technology, the Netherlands
[3]Department of Experimental Psychology & Helmholtz Institute, Utrecht University, the Netherlands
[1,2]{P.An, S.Bakker, R.Taconis, J.H.Eggen}@tue.nl; [3]C.L.E.Paffen@uu.nl

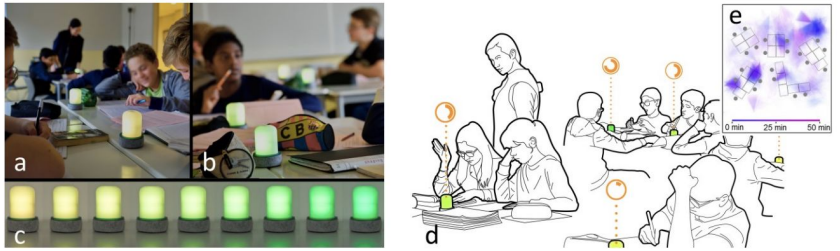




Figure 1. (a)(b): ClassBeacons system (c): each lamp depicts how long the teacher has been around it by changing from yellow (no time spent) to green (440 seconds spent) (d): the system supports teachers' reflection-in-action on how they have divided time and attention over students in the classroom (e): the display is based on teachers' real-time positioning data.

**Which topic?**

# Match Topic!

- Systems for collaborative learning and social discussion
- Multimedia interfaces for learning
- Technology-supported learning
- Tangible learning interfaces.
- Intelligent tutoring systems
- Learning analytics
- Teacher/educator-facing designs

CHI 2024
Surfing the World

**OATutor: An Open-source Adaptive Tutoring System and Curated Content Library for Learning Sciences Research**


Zachary A. Pardos
UC Berkeley School of Education
Berkeley, CA, USA
pardos@berkeley.edu

Matthew Tang*
UC Berkeley EECS
Berkeley, CA, USA
matthewtang@berkeley.edu

Ioannis Anastasopoulos*
UC Berkeley School of Education
Berkeley, CA, USA
ioannisa@berkeley.edu

Shreya K. Sheel*
UC Berkeley School of Education
Berkeley, CA, USA
shreya_sheel@berkeley.edu

Ethan Zhang
UC Berkeley EECS
Berkeley, CA, USA
ethanzhang@berkeley.edu


## Intelligent Tutoring System

**Motivation as a Lens to Understand Online Learners: Toward Data-Driven Design with the OLEI Scale**


RENÉ F. KIZILCEC and EMILY SCHNEIDER, Stanford University


## Learning analytics

*research and practice that uses computational analysis of learning process data to better understand and improve learning.

**Unobtrusively Enhancing Reflection-in-Action of Teachers through Spatially Distributed Ambient Information**


Pengcheng An[1] Saskia Bakker[1] Sara Ordanovski[3] Ruurd Taconis[2] Chris L.E. Paffen[3] Berry Eggen[1]
[1]Department of Industrial Design, Eindhoven University of Technology, the Netherlands
[2]Eindhoven School of Education, Eindhoven University of Technology, the Netherlands
[3]Department of Experimental Psychology & Helmholtz Institute, Utrecht University, the Netherlands
[1,2]{P.An, S.Bakker, R.Taconis, J.H.Eggen}@tue.nl; [3]C.L.E.Paffen@uu.nl

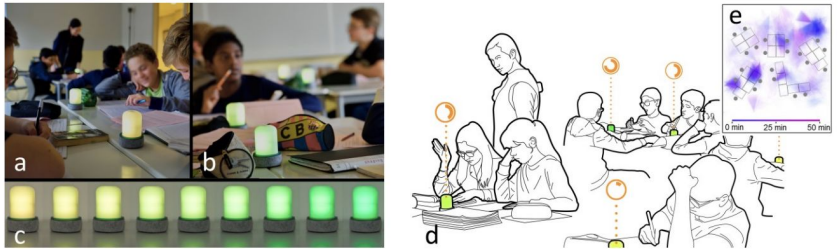




Figure 1. (a)(b): ClassBeacons system (c): each lamp depicts how long the teacher has been around it by changing from yellow (no time spent) to green (440 seconds spent) (d): the system supports teachers' reflection-in-action on how they have divided time and attention over students in the classroom (e): the display is based on teachers' real-time positioning data.

## Teacher/educator-facing designs

# Main Contributions to CHI


**Understanding Users**

- Do you clearly describe the methodology and mechanics behind the analysis (e.g., ethnographic, field investigation, interviews, contextual inquiry)?


**Development/Refinement of Interface artifacts or techniques**

- Do you provide context, where you clearly review what is already known and what limitations exist in knowledge about this artifact or technique?
- Do you include a rigorous and convincing validation of the artifact/technique (e.g., empirical study, usability study, field study as appropriate), where you clearly show that incremental gains not only exist, but that the gains are of practical significance?


**Systems, Tools, Architectures, and Infrastructure**

- Is the idea placed in context, where you detail the expected situation, tasks and users?
- Do you provide sufficient information for an experienced researcher to implement a similar system?


**Innovation, Creativity, and Vision**

- Is the idea novel or a significant variation of an existing idea?
- Do you convincingly describe the potential significance and impact of this work, where you clearly argue about its significance, how it enables a new class of user interfaces or user experiences, and how it can affect future generations of users?
- Do you stimulate thought on new ways to interact with technology, or how new cultural meanings will be applied to the technology we build?

# Related Venues - ??


## IDC

“ACM Interaction Design and Children Conference”

idc.acm.org/2024/

## L@S

“Learning at Scale”

learningatscale.acm.org/home/

## CSCW

“Computer-Supported Cooperative Work ”

dl.acm.org/conference/cscw

# Related Venues - Definition


"Inclusive child-centered design, learning, and interaction."

idc.acm.org/2024/

acm L@S

"...large-scale, technology-mediated learning environments that typically have many active learners and few experts on hand to guide their progress or respond to individual needs."

learningatscale.acm.org/home/

CSCW 2024

"...design and use of technologies that affect groups, organizations, and communities."

dl.acm.org/conference/cscw

# Related Venues - Selected Examples!!


- "Designing the future of technology for and with children
- Designing for sustainability (environmental, institutional, developmental etc)
- Equity, diversity, inclusion, and social justice as it relates to the lives of children"

idc.acm.org/2024/areas-of-interest/

- **massive open online courses (MOOCs)**, open courseware
- mobile learning applications
- **learning games**, intelligent tutoring systems
- collaborative programming communities (e.g. Scratch)
- community tutorial systems (e.g. StackOverflow)

learningatscale.acm.org/home/

- CSCL: computer-supported collaborative learning (en.wikipedia.org/wiki/Computer-supported_collaborative_learning)

dl.acm.org/conference/cscw

# Contributions Beyond HCI

| | |
|---|---|
| **ACM SIGCSE** | ACM Special Interest Group Computer Science Education<br>sigcse.org/ |
| **ACM CompEd** | ACM Global Computing Education Conference<br>comped.acm.org/ |
| **ICSE-SEET** | International Conference on Software Engineering: Software Engineering Education and Training<br>conf.researchr.org/track/icse-2024/icse-2024-software-engineering-education-and-training-track |
| **IRECONF** | International Conference on Innovative Research in Education<br>ireconf.org/about-conference |

# Framing Papers

**#1. Cooperative inquiry: Developing new technologies for children with children**

**#2. Another Decade of IDC Research: Examining and Reflecting on Values and Ethics**

# Cooperative Inquiry: Developing New Technologies for Children and with Children

Allison Druin. CHI (1999).

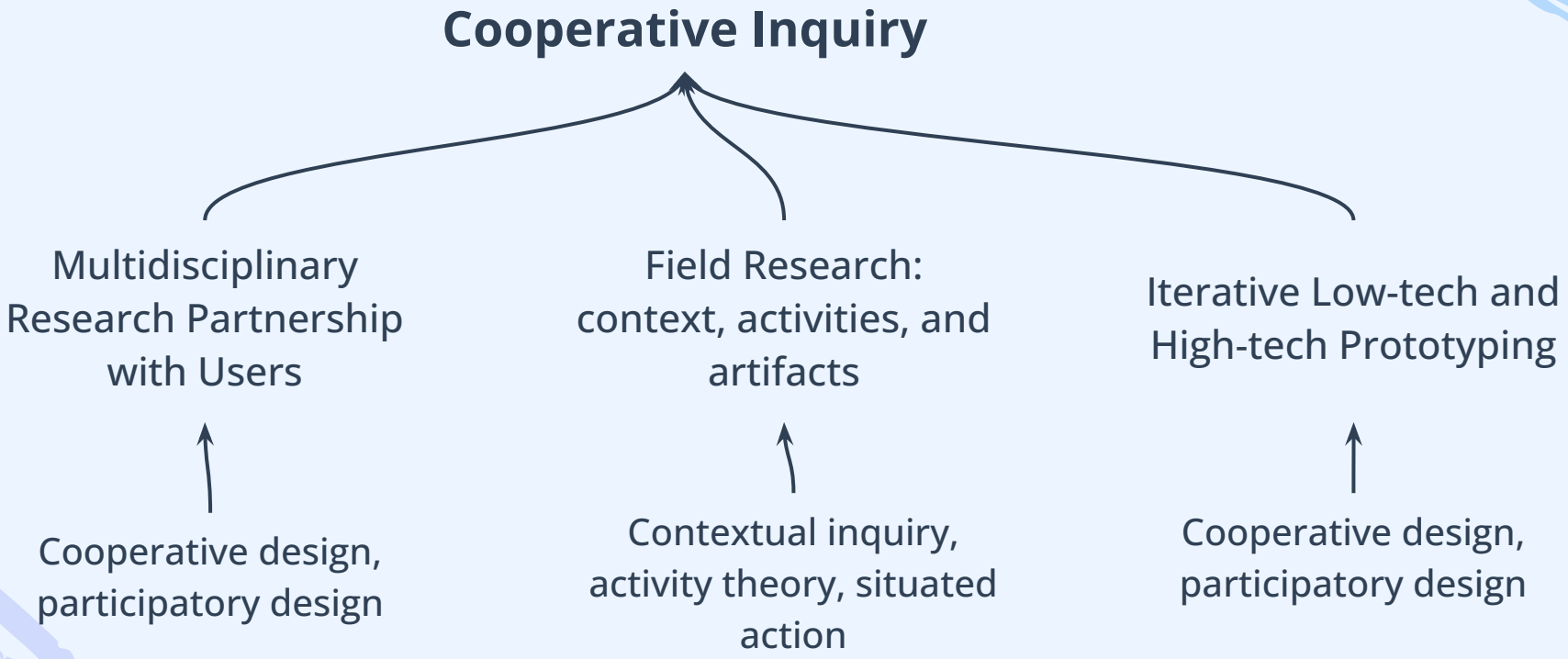
# Background:

- Published @ CHI ‘99 (May 15-20, 1999)
- Author: Allison Druin (ischool.umd.edu/directory/allison-druin/)
  - Research Interests:
    - Children’s information access and use, digital libraries for children, user interface design, children’s storytelling processes, and tools.
  - HCI Lab @ University of Maryland

# Summary

- **New research approach** to involve children as active partners in the research
- **Cooperative inquiry draws from HCI methodologies**
- The author presents **a theoretical framework** that situates cooperative inquiry in the HCI literature
- Two projects utilize the cooperative inquiry approach (KidPad and PETS)
- The implications of the cooperative inquiry process is **design-centered learning**

# A Theoretical Framework



# Cooperative Inquiry: The Research Methods

1

**Contextual Inquiry**

2

**Participatory Design**

3

**Technology Immersion**

# Contextual Inquiry

- Adapted this technique to use with children
- Both adults and children observe, take notes, and interact with child users
- Adults take notes while children draw
- Both adults and children had difficulty being interactors

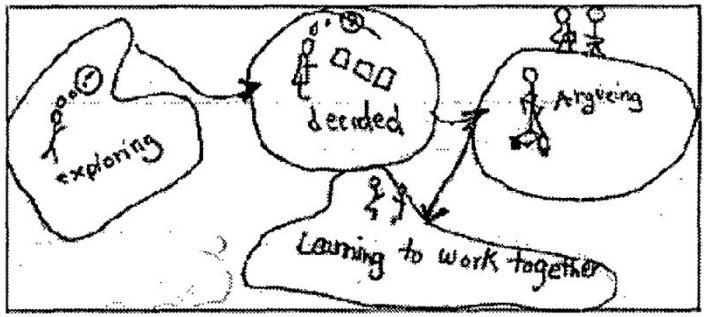



**Figure 1: Contextual inquiry notes by a 7-year old child**

| RAW DATA: | | | DATA ANALYSIS: | | |
|---|---|---|---|---|---|
| Time | Quotes | Activities | Activity Patterns | Roles | Design Ideas |
| 39:20 | "I want the playing one." | Child clicks on the scared cat and tries to take out another one. It doesn't work. | Difficulty with mouse dragging. | | Look for alternative input devices or don't use dragging with a mouse. |
| 39:50 | "Awww. The kitten was afraid." | Child clicks on another basket with a cat. | Tells stories about actions on screen. | Storyteller | Offer children storytelling opportunities with technology. |
| 40:20 | "Which one's the playful one?" | Child looks for a playful cat. | Child knows what she likes. | Searcher | |
| 41:00 | "I don't want to name my kitty." | Child doesn't name her cat when prompted to by the computer. | Child knows what she likes. | | |
| 41:30 | "That's to give milk." | Child clicks on different icons to see what they do. | Tests out what can be done. | Explorer | Make technology easy to explore. |

**Table 1: Portion of a contextual inquiry diagram created by adults**

# Participatory Design

- Helpful to go after contextual inquiry
- Author found children ages 7-10 to be most effective prototyping partners
- Low-tech prototyping = art supplies, some children, and some adults
- Space for discussion and collaborative brainstorming activities

# Technology Immersion

- The goal is to understand children’s technology wants or needs
- Through this method, researchers can observe how children use large amounts of technology over a concentrated period of time
- Children are the decision makers while using technology

# Cooperative Inquiry in Practice

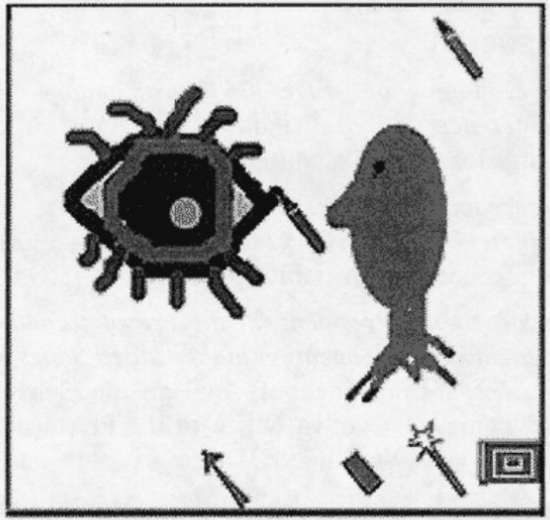


Figure 2: “The Eye”, a story made in KidPad

KidPad

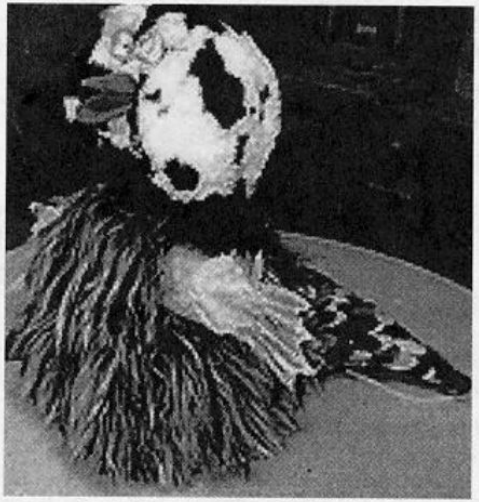


Figure 3: PETS robotic storytelling animal

PETS

# Design-Centered Learning

- Learning as an outcome of cooperative inquiry
- Occurs to all parties involved (children & adults, novices & technology experts, technical & non-technical professionals)

| |
|---|
| **(1) I learned about the design process**<br>All team members discussed understanding the technology design process in new ways. |
| **(2) I learned respect for my design partners**<br>Both adults and children discussed their mutual appreciation for the work that the other could accomplish. |
| **(3) I learned to communicate and collaborate in a team**<br>Children and adults discussed the difficulties and the rewards of learning team communication and collaboration skills. |
| **(4) I learned new technology skills and knowledge**<br>All team members mentioned technical skills they had come to learn (e.g., building robots, designing software). |
| **(5) I learned new content knowledge**<br>In the case of the team working on the PETS project, children and adults discussed learning more about animals. |

**Table 2: Self-reported design-centered learning**

# What are the contributions of this paper? ☺️

**Has anyone used cooperative inquiry or similar methods? Or plan to?**

# Another Decade of IDC Research: Examining and Reflecting on Values and Ethics

Saba et al. IDC (2020).

# Background:

- Published @ IDC ‘20 (June 21, 2020)
  - “The IDC (Interaction Design and Children) conference series began in 2002, when a workshop was held in Eindhoven, NL that brought together researchers and practitioners seeking to study how best to develop and design interactive technologies for children.”
    (https://dl.acm.org/doi/proceedings/10.1145/3078072).

# Summary

- Discuss the **trends of research contributions and the core value** over the past two decades of full IDC published papers by conducting a content analysis (2011 to 2019) and a survey with the first authors of 20% of these papers.

- The types of contribution in IDC papers
- Behaviors and qualities IDC aspired to support in children
- Roles of children and stakeholders in design process
- Criteria informing IDC's technical design choices
- etc.

# Findings

## The types of contribution in IDC papers

Moderately increasing trend for empirical contributions compared to the first decade.

Artifact category seemed to show a strong declining trend over the past two decades.

***Q. Why does this phenomenon happens?***

**Table 1. Codes addressing primary contributions, the percent of papers that were tagged with this code, and trends over time.**

| Paper Primary Contribution | | | | | | |
|---|---|---|---|---|---|---|
| Code | 2002-2010 | | 2011-2019 | | 2002-2019 | |
| | % | Trend | % | Trend | % | Trend |
| Contributes an Empirical Study | 45 | -0.14 | 61 | 0.34 | 55 | 0.46 |
| Contributes an Artifact | 43 | 0.64 | 23 | -0.36 | 31 | -0.51 |
| Contributes a Method | - | - | 6 | 0.28 | - | - |
| Contributes a Theory | - | - | 5 | 0.10 | - | - |
| Contributes a Research Review | - | - | 4 | 0.02 | - | - |
| Contributes a Reflection | 12 | -0.38 | 1 | 0.02 | 5 | -0.59 |
| Contributes a Dataset Corpus | - | - | 0 | - | - | - |
| **Paper Contribution Values** | | | | | | |
| Design and Evaluate in Context | 7 | -0.66 | 40 | 0.005 | 27 | 0.73 |
| Understanding Children's Models | 18 | -0.12 | 39 | -0.11 | 31 | 0.43 |
| Examine our Methods | 21 | -0.73 | 17 | 0.17 | 18 | -0.37 |
| Makes an Explicit Appeal to IDC | 11 | -0.70 | 15 | 0.02 | 13 | -0.09 |
| Conflict between Goals and Methods | 8 | -0.34 | 8 | 0.23 | 8 | -0.10 |

# Findings

## Behaviors and qualities IDC aspired to support in children

Researchers aimed to support children in developing social skills, collaborating with their peers to share knowledge and design, and cultivating environments where peers could freely interact with one another (e.g. facilitating effective group work).

Researchers designed technologies and conducted investigations concerned with understanding how these factors can contribute to children's learning.

Researchers also investigated learning as an opportunity to support cognitive development in children.

**Table 2. Codes addressing qualities IDC aspires to support in children, the percent of papers that were tagged with this code and trends over time.**

| Code | 2002-2010 | | 2011-2019 | | 2002-2019 | |
|---|---|---|---|---|---|---|
| | % | Trend | % | Trend | % | Trend |
| **Social Interaction & Connectedness** | | | | | | |
| Social Interaction | 41 | 0.45 | 41 | 0.77 | 41 | 0.29 |
| Collaboration | 28 | 0.44 | 35 | -0.21 | 32 | 0.38 |
| Family Connectedness | 4 | 0.56 | 7 | 0.19 | 6 | 0.39 |
| Competition | 4 | 0.06 | 0.5 | 0 | 2 | -0.24 |
| **Learning** | | | | | | |
| Learning | 14 | -0.11 | 56 | -0.32 | 40 | 0.66 |
| Exploration | 15 | -0.17 | 30 | -0.52 | 24 | 0.26 |
| Fluency with Technology | 9 | -0.12 | 17 | 0.16 | 14 | 0.37 |
| Support Cognitive Development | 7 | 0.72 | 16 | 0.25 | 13 | 0.72 |
| Inquiry | 7 | -0.03 | 14 | -0.42 | 11 | 0.23 |
| Programming/Coding | 12 | 0.17 | 12 | -0.08 | 12 | -0.04 |
| Reflection | 7 | 0.06 | 12 | 0.15 | 10 | 0.35 |
| Literacy | 9 | -0.51 | 8 | -0.03 | 8 | -0.31 |
| Learning Real World Skills | 6 | -0.36 | 7 | 0.69 | 7 | 0.09 |
| **Expression** | | | | | | |
| Self-Expression | 18 | -0.62 | 20 | 0.05 | 20 | -0.01 |
| Creativity | 17 | 0.01 | 20 | 0.43 | 19 | 0.15 |
| Narratives | 18 | -0.02 | 11 | 0.46 | 14 | -0.35 |
| Imagination | 7 | 0.52 | 7 | 0.50 | 7 | 0.22 |
| **Play** | | | | | | |
| Playfulness | 10 | 0.36 | 31 | -0.09 | 23 | 0.75 |
| Physical Activity | 9 | 0.57 | 11 | 0.12 | 10 | 0.34 |
| **Personal Growth** | | | | | | |
| Attitude & Motivation | 4 | -0.07 | 16 | 0.35 | 11 | 0.65 |
| Equity of Participation | 5 | -0.46 | 12 | -0.31 | 9 | 0.31 |
| Autonomy | - | - | 12 | 0.63 | - | - |
| Identity | - | - | 4 | 0.62 | - | - |
| Morality & Ethics | 3 | -0.41 | 3 | -0.50 | 3 | -0.17 |
| Autonomy & Identity | 7 | -0.59 | - | - | - | - |
| **Health & Well-being** | | | | | | |
| Health/Well-being | - | - | 12 | 0.59 | - | - |
| **Other** | | | | | | |
| Have Children Buy Products | 1 | -0.13 | 0 | - | 1 | -0.35 |

# Findings

## Roles of children and stakeholders in design process

Children as design partners shows a strong decline trend over the two decades. (...) Despite this declining trend, (...) authors (...) advocated for making sure children's perspectives are represented in the desired outcome (e.g., artifact or intervention).

Including teachers seems to have a strong increasing trend over the two decades. (...) Researchers leverage teachers' expertise in children's learning and development when designing technology systems.

***Q. Why does this phenomenon happens?***
***Q. How does this phenomenon affect IDC research?***

**Table 3. Codes addressing for whom IDC designs, the percent of papers that were tagged with this code, and trends over time.**

| Code | 2002-2010 | | 2011-2019 | | 2002-2019 | |
|---|---|---|---|---|---|---|
| | % | Trend | % | Trend | % | Trend |
| **Role of Child in Design** | | | | | | |
| Tester | 39 | 0.86 | 35 | -0.11 | 37 | 0.06 |
| User | - | - | 29 | -0.31 | - | - |
| Informant | 8 | 0.08 | 13 | 0.37 | 11 | 0.36 |
| Design Partner | 29 | -0.82 | 12 | 0.25 | 18 | -0.70 |
| None | - | - | 9 | 0.14 | - | - |
| **Role of School** | | | | | | |
| Including Teachers | 5 | -0.42 | 18 | 0.01 | 13 | 0.60 |
| Curricular Integration | 14 | -0.05 | 15 | -0.13 | 15 | -0.01 |
| Balance Multiple Stakeholder | 9 | -0.50 | 13 | 0.15 | 11 | 0.14 |
| Whole Class Activities | 2 | 0.67 | 12 | -0.37 | 8 | 0.73 |
| **Codesign Values** | | | | | | |
| Reflect Children's Voices | 14 | -0.79 | 20 | 0.39 | 18 | 0.12 |
| Children as Active Agents | 20 | 0.07 | 15 | 0.18 | 17 | -0.12 |
| Equalize Power btw Child & Researcher | 9 | -0.67 | 6 | 0.21 | 7 | -0.30 |
| **Diversity Values** | | | | | | |
| Design for Special Needs | 12 | 0.75 | 15 | -0.02 | 14 | 0.28 |
| Engaging the Underserved | 7 | 0.17 | 12 | 0.27 | 10 | 0.39 |
| Gender Awareness | 11 | -0.39 | 8 | 0.48 | 9 | -0.27 |
| Design for MultiInteraction Styles | 15 | -0.24 | 5 | -0.22 | 8 | -0.59 |
| Culturally-Appropriate | 4 | 0.01 | 5 | 0.63 | 5 | 0.22 |
| Design for All Genders | 6 | -0.65 | 2 | -0.45 | 3 | -0.52 |

# Findings

## Criteria inform IDC's technical design choices

Although we observed a higher percentage of technology engagement discussion in the papers from the second decade, the discussion was decreasing in recent years. One reason for this decrease could be that researchers have moved beyond engagement and want to support wider range of attributes.

***Q. What affect the decrement of engagement study?***

**Table 5. Codes addressing values in the technical design, the percent of papers that were tagged with this code, and trends over time.**

| Code | 2002-2010 | | 2011-2019 | | 2002-2019 | |
|---|---|---|---|---|---|---|
| | % | Trend | % | Trend | % | Trend |
| **Attributes Valued** | | | | | | |
| Engagement | 24 | 0.69 | 36 | -0.51 | 32 | 0.57 |
| Learner-Centered Design | 4 | 0.27 | 21 | -0.10 | 14 | 0.65 |
| Enjoyment | 24 | -0.30 | 20 | 0.23 | 22 | -0.21 |
| Designing for the Experience | 4 | -0.18 | 15 | -0.28 | 10 | 0.46 |
| Feedback | 9 | 0.12 | 14 | 0.06 | 12 | 0.31 |
| Customizability | 4 | 0.42 | 10 | -0.67 | 8 | 0.56 |
| Simplicity | 4 | 0.29 | 10 | 0.01 | 8 | 0.42 |
| Desirability | 14 | -0.55 | 8 | -0.07 | 10 | -0.44 |
| Multiple Senses | 4 | 0.08 | 6 | 0.53 | 5 | 0.12 |
| Naturalness (Intuitive) | 20 | 0.12 | 5 | -0.08 | 11 | -0.55 |
| Challenge | 7 | 0.17 | 5 | -0.43 | 5 | -0.19 |
| Efficiency or Task Completion | 6 | 0.50 | 5 | -0.80 | 5 | -0.08 |
| Cost Effectiveness | 3 | 0.50 | 4 | -0.16 | 4 | 0.19 |
| Engagement in the Long Term | 3 | 0.24 | 3 | -0.40 | 3 | 0.01 |
| Aesthetics | 3 | 0.15 | 2 | 0.02 | 2 | -0.14 |
| **Technical Choices** | | | | | | |
| Tangibles | 26 | 0.30 | 20 | -0.18 | 22 | -0.28 |
| Bridging Physical and Digital | 11 | 0.54 | 15 | -0.61 | 14 | 0.28 |
| Innovate and Explore Novel Technologies | 8 | -0.51 | 7 | -0.30 | 8 | -0.23 |
| Mixed Reality | 15 | 0.58 | 5 | 0.02 | 9 | -0.17 |
| **Platform** | | | | | | |
| Tangibles & Smart Objects | - | - | 20 | -0.21 | - | - |
| Mobile Technologies | - | - | 19 | -0.25 | - | - |
| Personal Computer | - | - | 13 | -0.76 | - | - |
| Shared interactive surfaces, tabletops | - | - | 8 | -0.70 | - | - |
| Sensor-based and Wearable | - | - | 6 | 0.16 | - | - |
| Virtual & Augmented Reality | - | - | 4 | 0.71 | - | - |
| Multisensory Environments | - | - | 2 | 0.06 | - | - |
| Natural User Interfaces | - | - | 2 | 0.63 | - | - |
| Robotics | - | - | 0 | - | - | - |
| **Relation to Current Practices** | | | | | | |
| Leverage Current Practices | 12 | -0.29 | 49 | 0.09 | 34 | 0.76 |
| Transform Current Practices | 2 | 0.07 | 23 | -0.38 | 15 | 0.51 |
| Concerns about Technology Negatives | 5 | 0.22 | 6 | 0.48 | 6 | 0.23 |

# Findings (Survey Result)

## Values informing IDC works

- Affording child agency
- Child-centered research process
- Encouraging broad participation
  - A wider range of demographics and abilities.
- Striving for research quality
  - Integrating relevant outside expertise in the research process,
  - Adhering to ethical guidelines.

## Ethical consideration of IDC researchers

- Beyond the Institutional Review Boards (IRBs)
  - Put efforts into explaining consent to the child
  - Consider the child's context-dependent needs currently not captured within IRB standards
- Being aware of responsibility
- Protecting privacy and safety

**Is contacting children directly more valuable than meeting parents or teachers in study?**

**How does this paper contribute to the HCI and Education communities respectively?**

## To HCI community

- **Theoretical contribution**
  - Deliver trends to do empirical research instead of making artifacts; build systems in service of research questions rather than to capitalize on technical novelty.

## To Education community

- **Theoretical contribution**
  - Deliver types and trends of technological study for children and education.

# Thanks!