iPads and apps as digital scaffolds for learning science in the primary school

Professor Garry Falloon
Department of Educational Studies
Macquarie University
Sydney
garry.falloon@mq.edu.au

THE UNIVERSITY OF WAIKATO
Te Whare Wānanga o Waikato

TEACHING & LEARNING RESEARCH INITIATIVE
NĀU I WHATU TE KĀKAHU, HE TĀNIKO TAKU

Background & context

- Study part of series of studies that commenced in June 2011
- Studies evolved from single class with university-supplied devices (iPads) to 4 x Bring Your Own Device (BYOD, Flexible Learning Spaces) and 3 x device-supported (conventional classes)
- Year levels K-6
- Values-based curriculum focused on collaborative learning and thinking and inquiry skill development

The Flexible Learning Spaces

Research questions

1. How were app scaffolds used by students to support their learning of basic energy science concepts?
2. How did teachers facilitate use of the apps, during the course of these students' self-directed science activities?

Theoretical referent

Scaffolding learning

> "scaffolding is characterized by continuous and constructive interactions between experts and learners as they work collaboratively to shift the locus of responsibility for task completion and learning from the expert to the learner" (Sharma & Hannafin, 2007, p. 29)

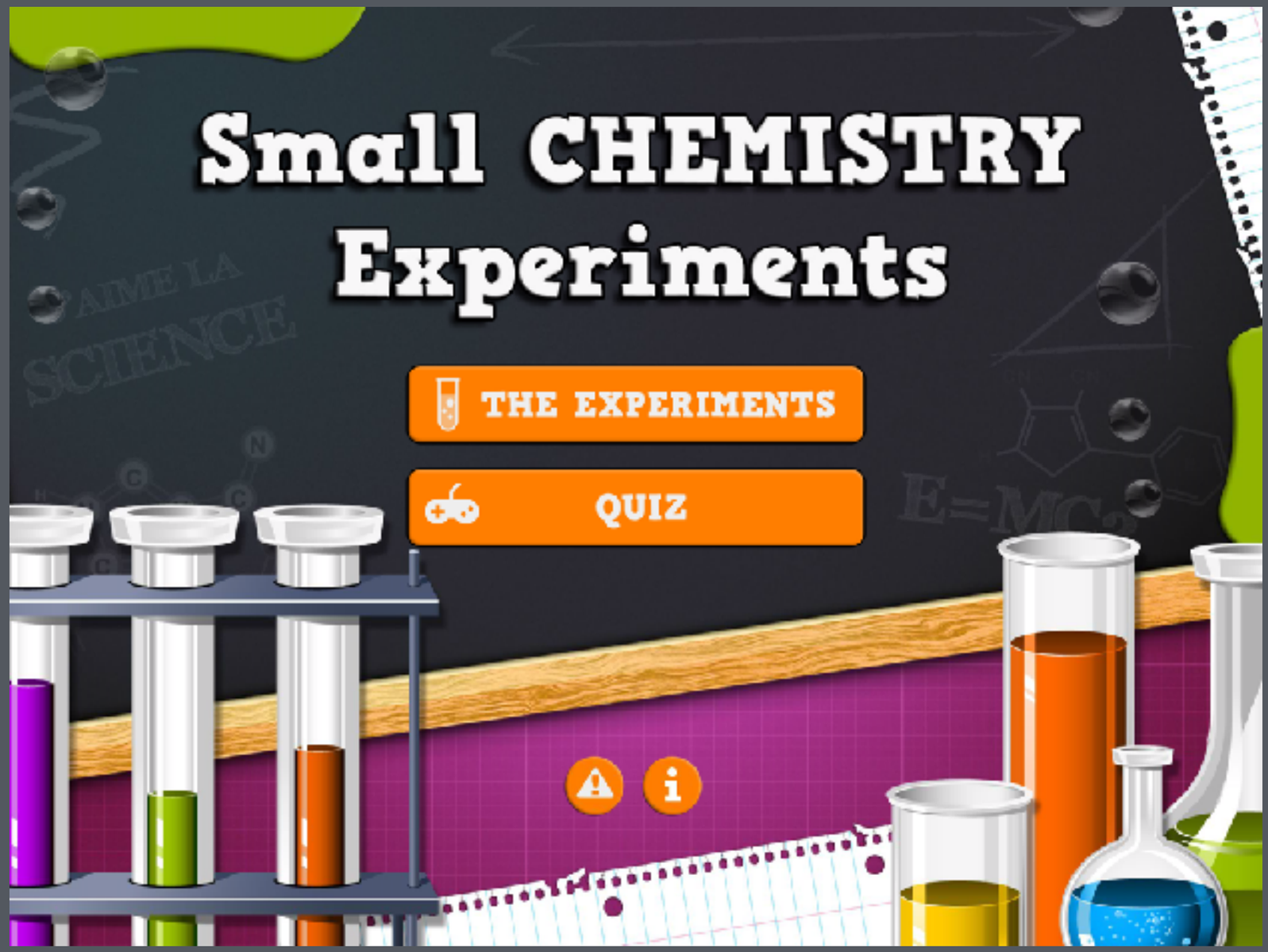
Technology-based scaffolding

> "technology-mediated support to learners as they engage in a specific learning task" (Sharma & Hannafin, 2007, p. 29)

Continuous technology-based scaffolding

> static scaffolds that "entail more fixed forms of guidelines, procedures or information" (Devolder, van Braak & Tinder, 2012, p.560)

The apps
Okiwibook science series



Collecting data

Challenges

- Mobile students in a variable teaching space
- Data authenticity (Hawthorne)
- Multiple groups completing different activities in different spaces at the same time
- Capturing the interaction between students, technology and practical science equipment and work
- Being non-disruptive to normal classroom activity
- Must be manageable but comprehensive

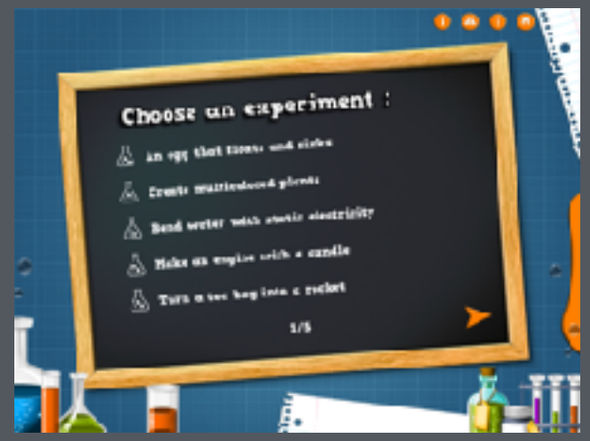
App scaffolds

Text based

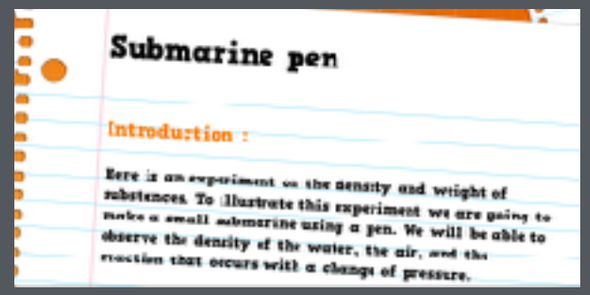
Images/graphical

Silent video

Experiment menu

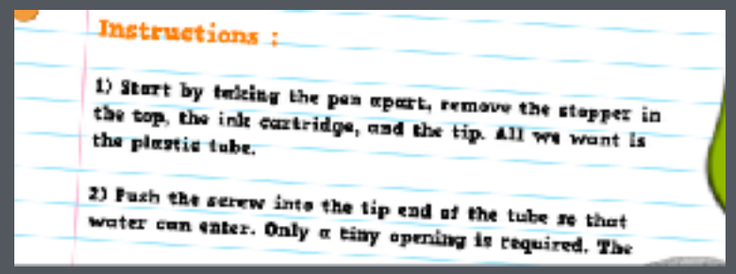


Introduction

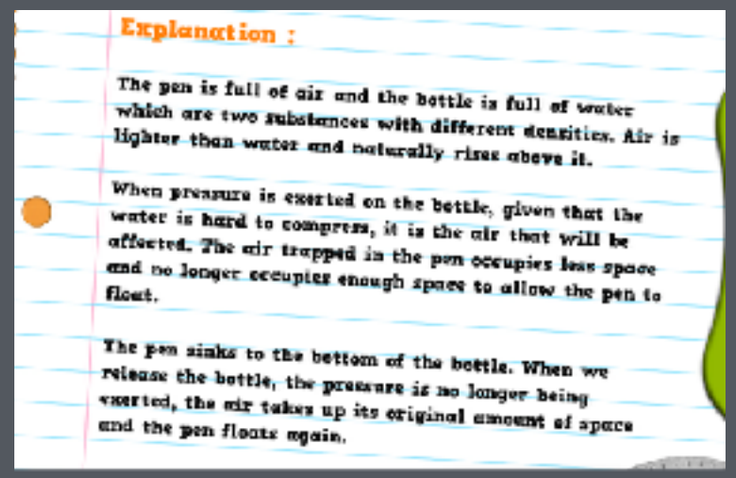


Equipment needed

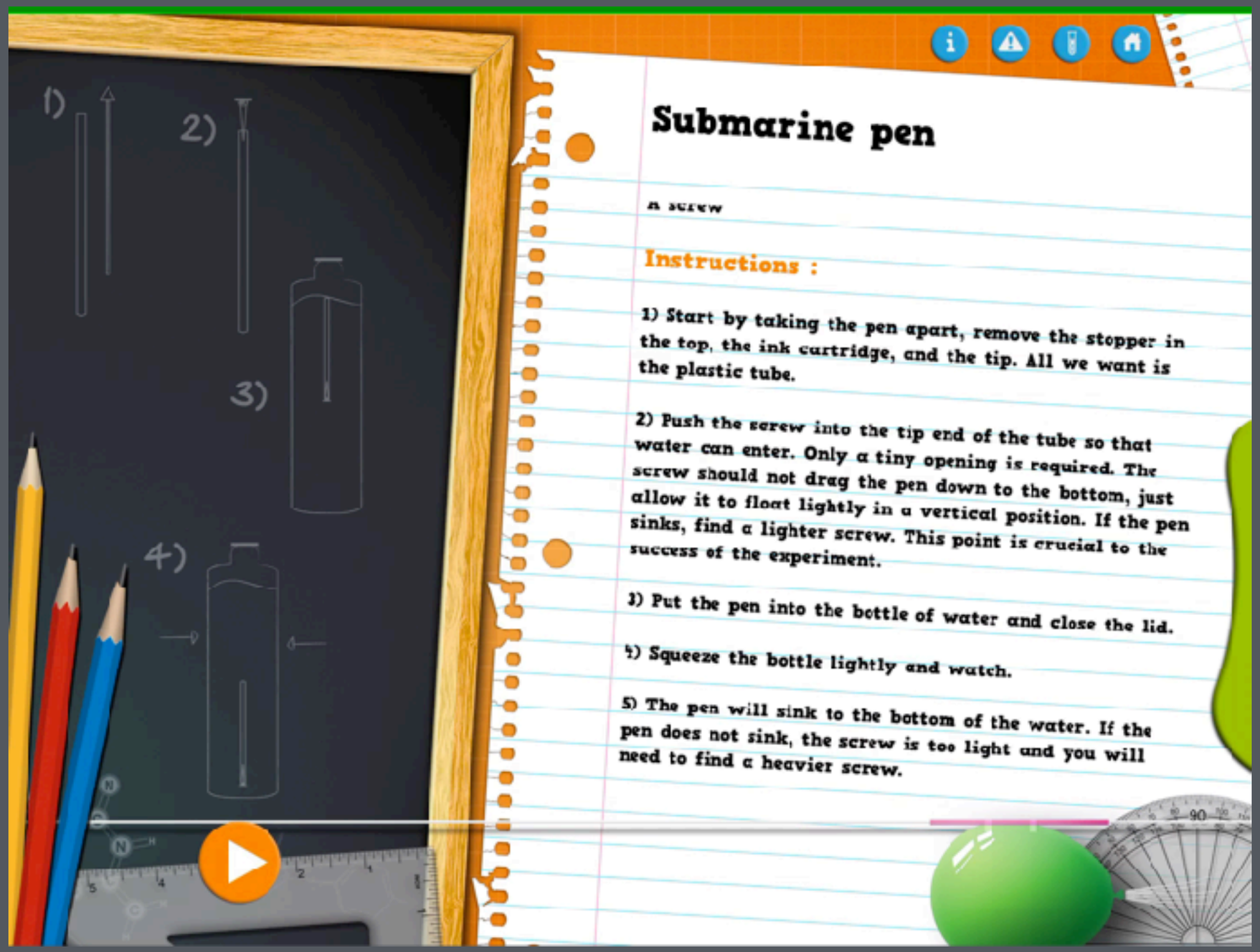
Instructions



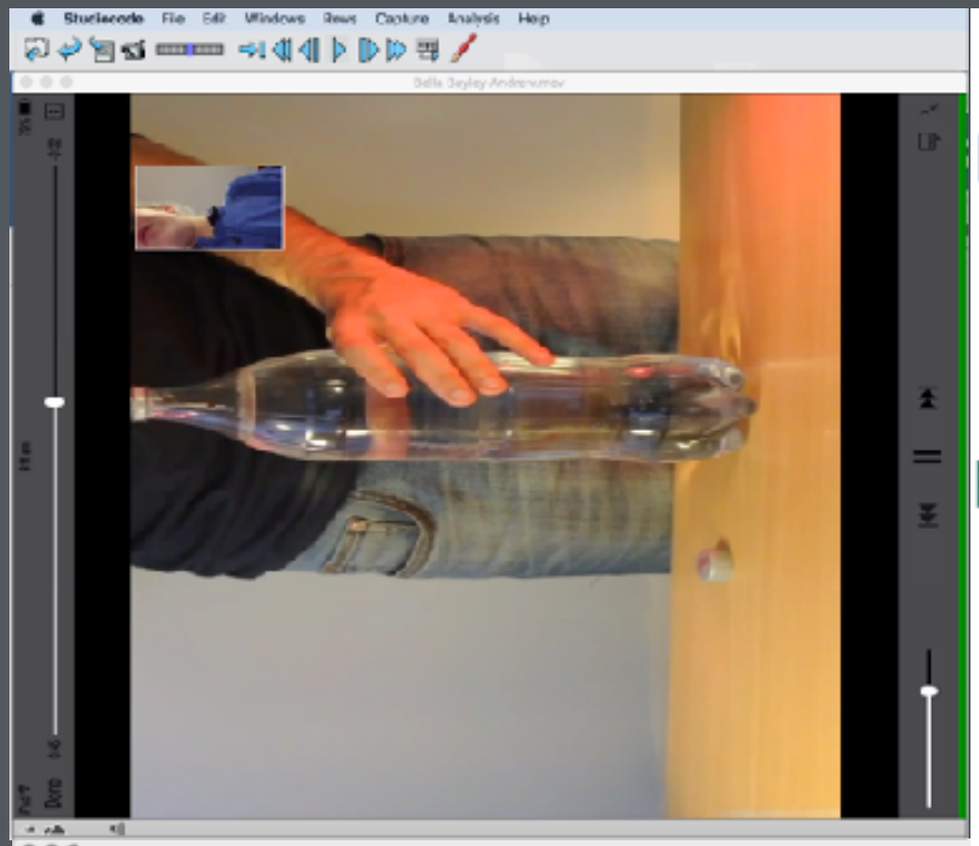
Explanations of science

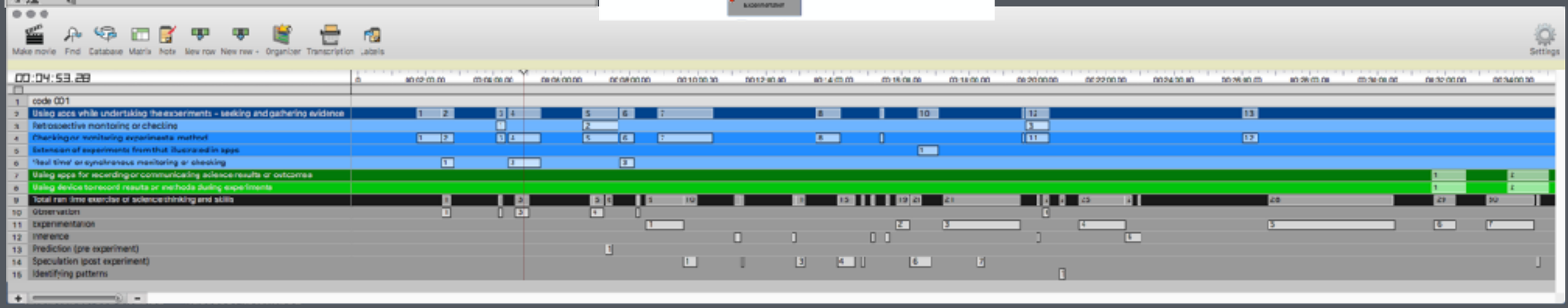


The in-device recording tool



Coding data using Studiocode





The coding template

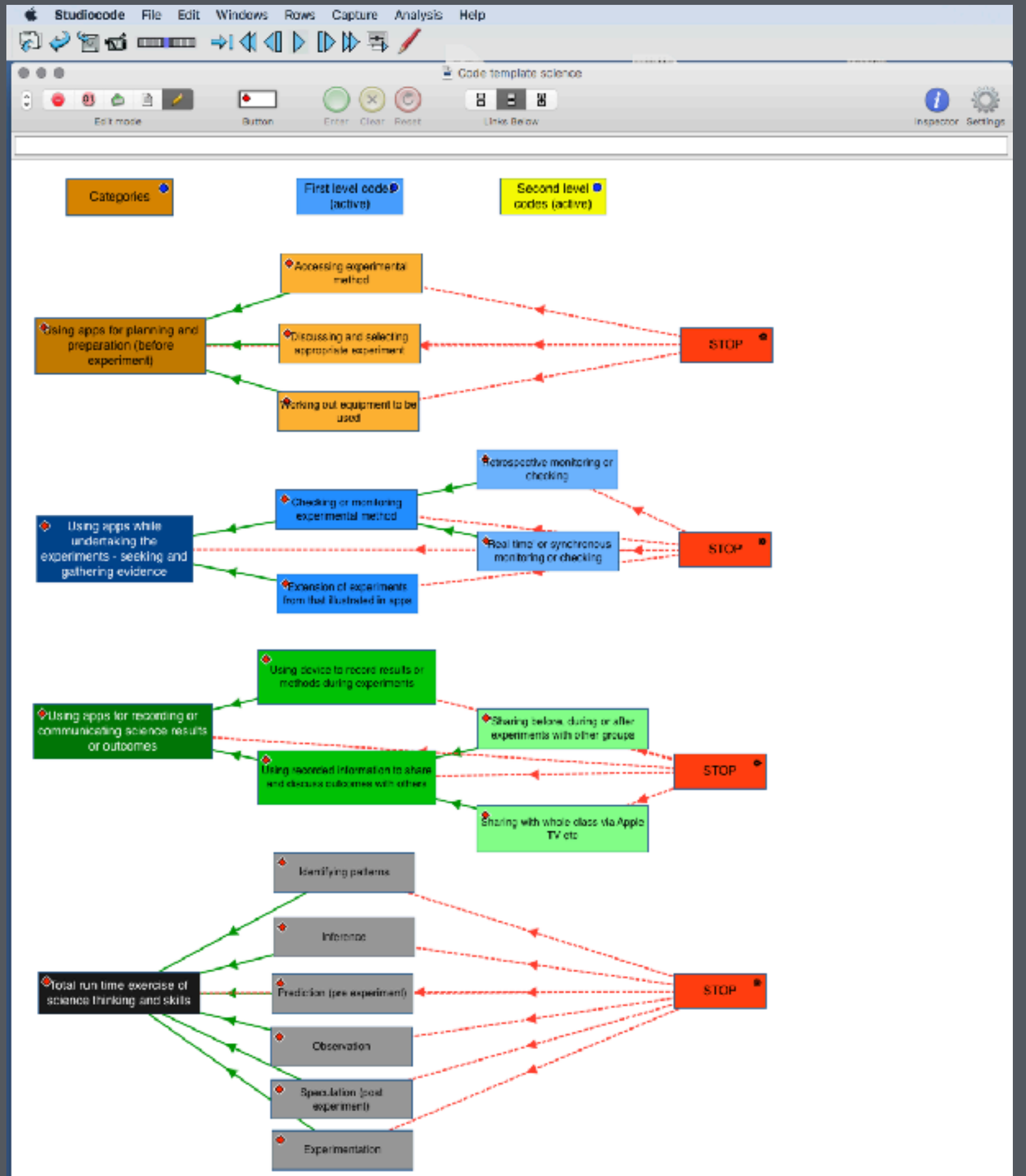
Data samples double blind reviewed (mix of abilities, science interest, collaborative skills, learning engagement)

Draft code categories identified and checked

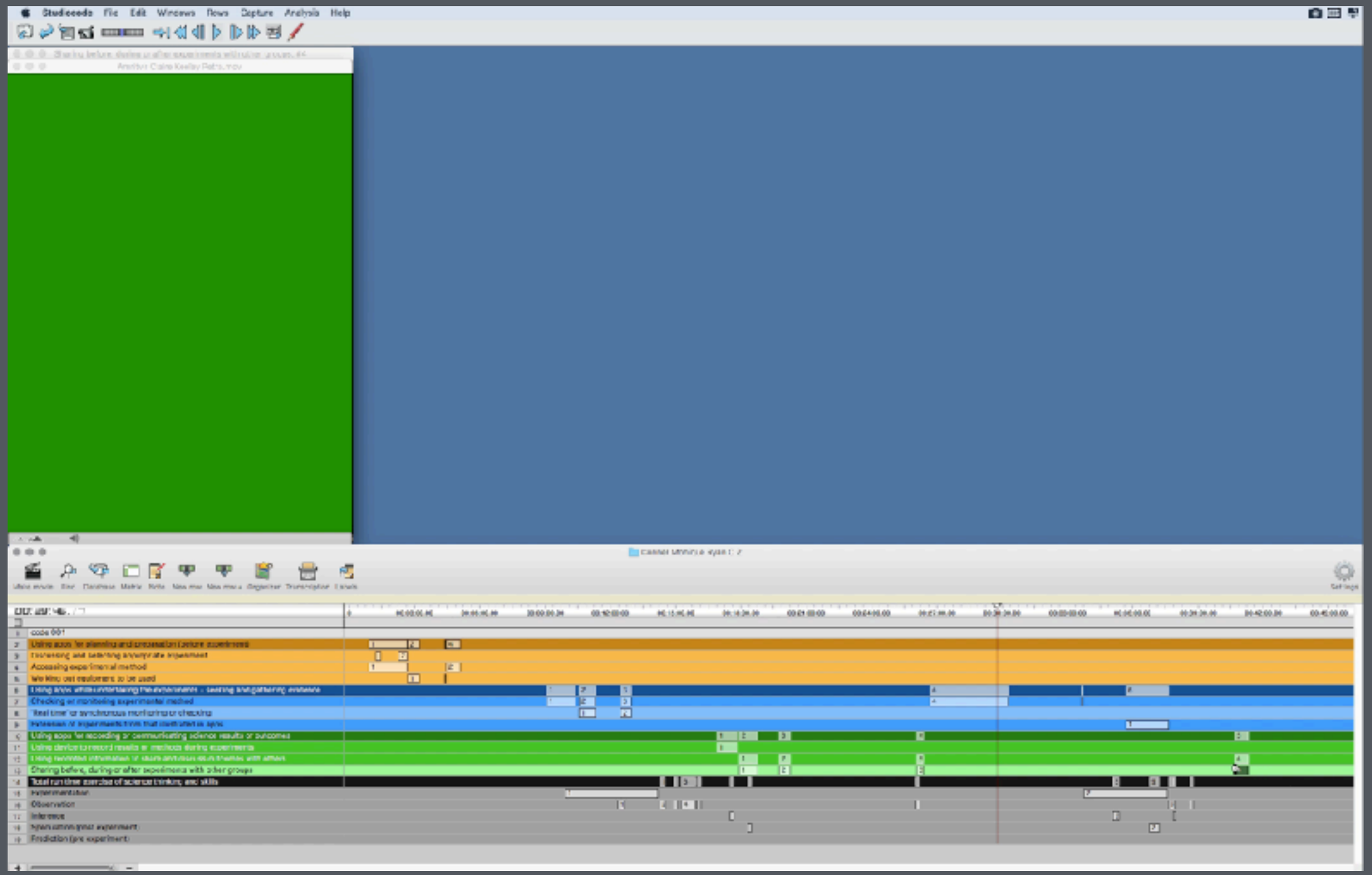
First level codes generated from categories

Second level codes generated & linked to first level

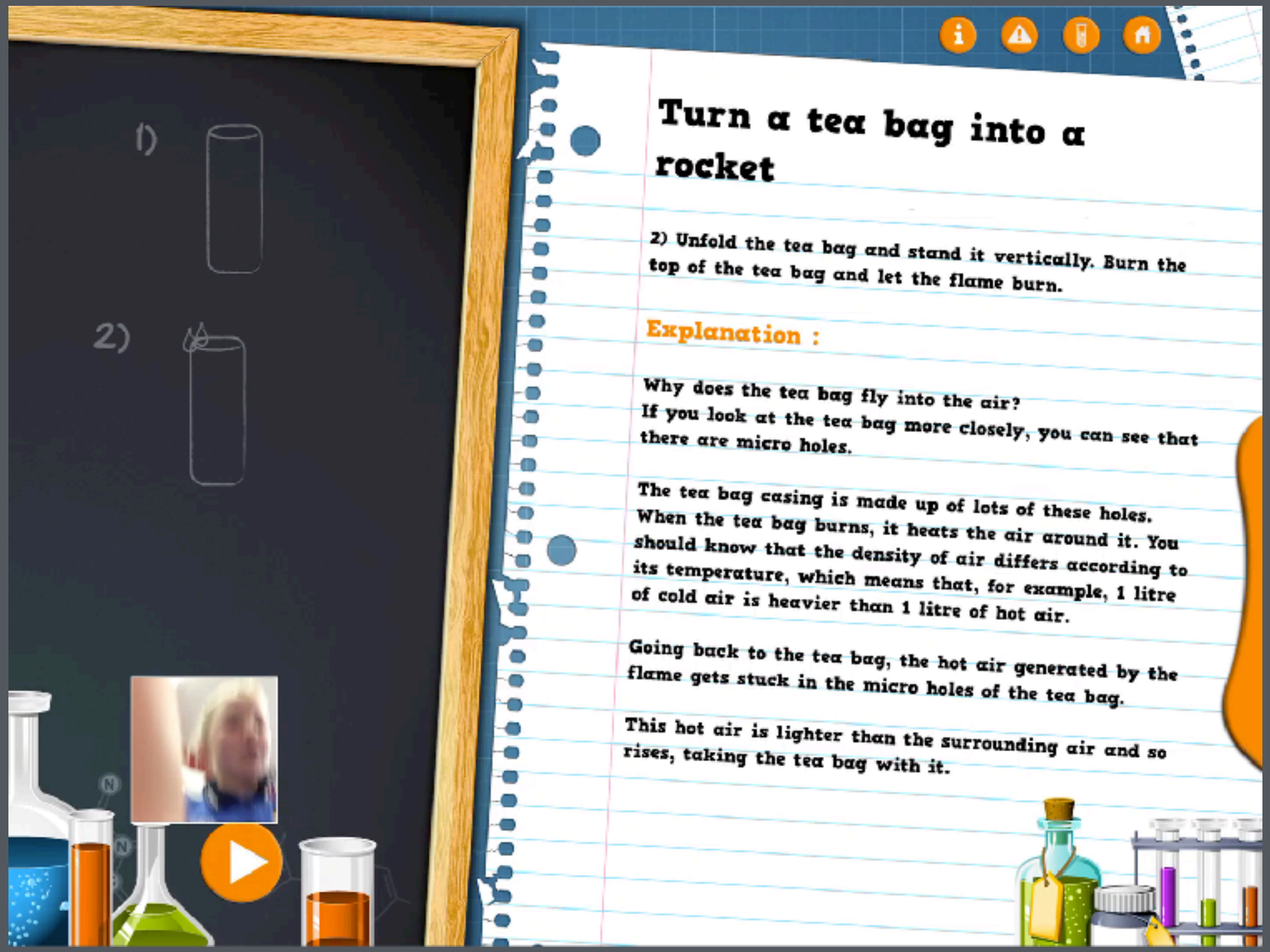
Sample re-coded (3 hrs) plus 7.5 hrs additional data (same criteria)
Random sample double blind



Sample data - understanding the method



Sample data - understanding the science (during experiments)



Data Analysis

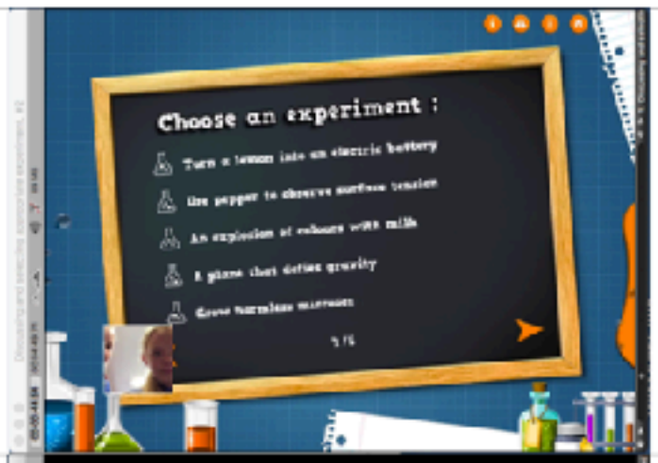
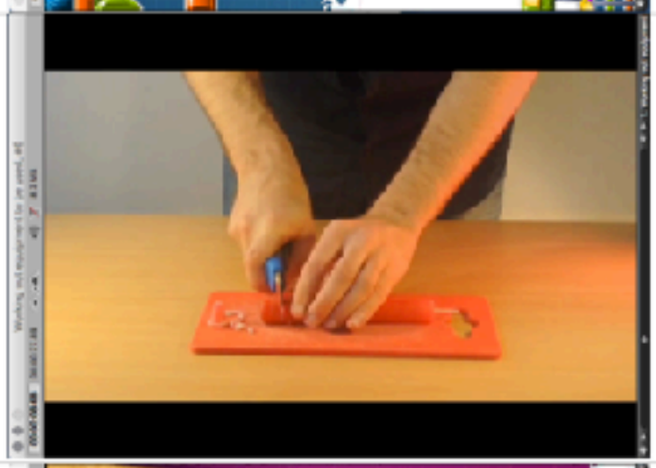
Raw data for each group exported to Excel

	A	B	C	D	E	F	G	H
1		BJ Brianna Abigail						
2		18						
3								
4		count	total time	converted to %		mean time	converted mean	
5								
6	Planning							
7	Planning and preparation (before experiment)	11	00:11:10.96	0.00776574	24.6	00:01:00.99	0.0007059	
8	Reviewing the experimental method	7	00:10:05.43	0.00700729	22.2	00:01:26.49	0.00100104	
9	Selecting an appropriate experiment from options	5	00:02:49.01	0.00195613	6.2	00:00:33.80	0.0003912	
10	Selecting materials to be used	9	00:03:12.98	0.00223356	7.08	00:00:21.44	0.00024815	
11								
12								
13	Methcd							
14	Understanding and accessing experimental method	5	00:07:31.51	0.00522581	16.55	00:01:30.30	0.00104514	
15	Checking method before experiment	4	00:04:32.61	0.00315521	10	00:01:08.15	0.00078877	
16	Checking method after experiment (summative)	0	00:00:00.00	0	0	00:00:00.00	0	
17	Checking and monitoring method during experiment (formative)	2	00:01:17.89	0.0009015	2.86	00:00:38.94	0.00045069	
18	Investigating variables	1	00:02:58.89	0.00207049	6.56	00:02:58.89	0.00207049	
19								
20	Recording and Communicating							
21	Recording and/or communicating results	5	00:16:04.82	0.0111669	35.38	00:03:12.96	0.00223333	
22	Recording methods and/or results during experiments	5	00:16:07.69	0.01120012	35.48	00:03:13.53	0.00223993	
23	Communicating methods and results to class (summative)	0	00:00:00.00	0	0	00:00:00.00	0	
24	Sharing methods or results with individuals or groups during experiments (formative)	0	00:00:00.00	0	0	00:00:00.00	0	

Sample data for publication purposes

Table 4.

Planning and preparation

Code	Sub category	Contextual information	Thumbnail image	Recorded dialogue
Planning and preparation (before experiment)	Selecting an appropriate experiment from range of options	Students A, C, K and P had opened the 'Small Science Experiments' app. They were reviewing the different experiments and discussing possible options. Dialogue indicates consideration of materials and compatibility with overall topic theme (two students are visible in the inset Faceeam).		"You've got to remember the stuff we've got K… we can do it if we haven't got the stuff… (materials)… (A). OK… let's have a look at this one… 'Use pepper to observe surface tension'… I wonder what surface tension is? (K, selecting option 2)… (pause)… Do we have dishwashing liquid… it says we need dishwashing liquid… (C)… I'll take a look (A)… (pause)… We can get some from J (another student) (A). Shall we try it then?… looks simple enough… (pause)… it says we should see a reaction… that fits OK" (P) (referring to chemistry topic theme).
	Selecting materials to be used	Students BJ, R & A had accessed the video to determine materials they needed for their 'candle engine' experiment. Although the app contained a materials text list, BJ suggested they use the video (due to his literacy issues the other students knew about).		"Can we go to the video… it'll be faster… (BJ)… But we can read it to you… (R)… (pause)… video's good… (A) (pause, video loads…) Right… let's see… we need a candle… (A) (pause)… …Looks like a carrot with a string! (BJ, laughing)… And he's almost cutting his fingers off! (A, laughing)… (pause)… Yeah… and a knife… and something to cut on… (pause)… d'we have a board? (R)… We can borrow Ds… he's got one" (BJ)…
	Reviewing the experimental method (planning)	Students C, M & RC had selected the 'Cold Lava Lamp' experiment from the range of options. They had checked on the availability of materials, and were reviewing the method (two students are visible in the inset Faceeam)		"Ok… let's see what we need to do… (pause)… (reads to others)… 'fill the glass or bottle with 5 to 10 centimetres of water' (M)… What d'ya think we should use? We've got a bottle AND a glass (RC)… Well… it's a jar, actually (C)… (pause)… Anyway… I reckon we should use the bottle, 'cos its bigger (RC)… …And it says we need to be careful when we pour in the oil… so that it doesn't mix (C)… What do you mean 'so it doesn't mix' they're both liquids aren't they? Why's that?" (RC)…

Results

How were technology scaffolds used by students to support their learning of basic energy science concepts?

Planning their experiments

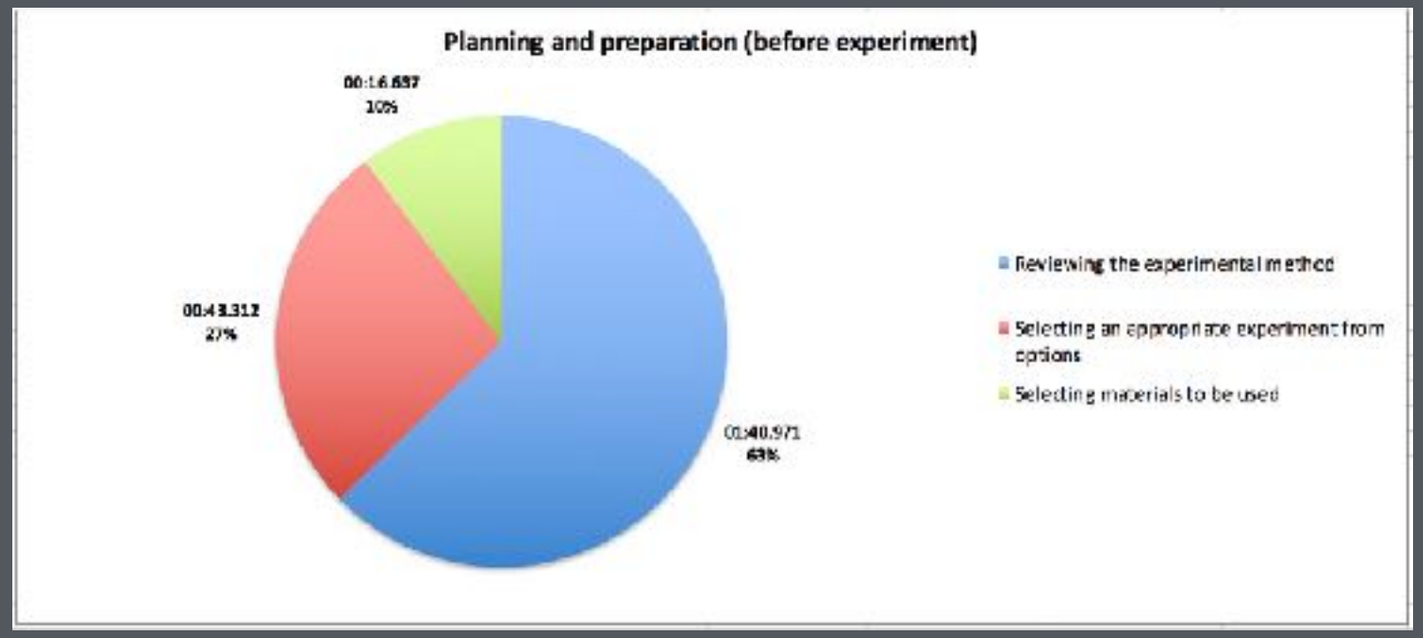
- selecting option
- initial review of method (viability)
- selecting and organising materials

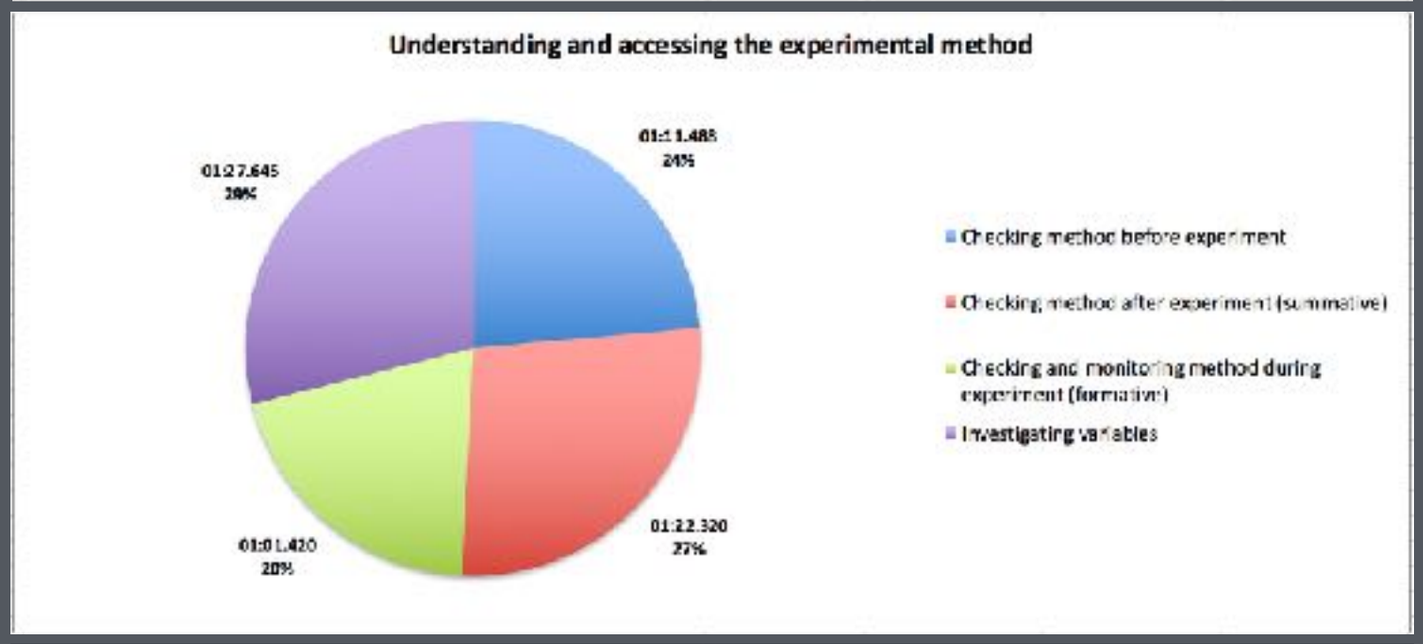
Checking and/or modifying method

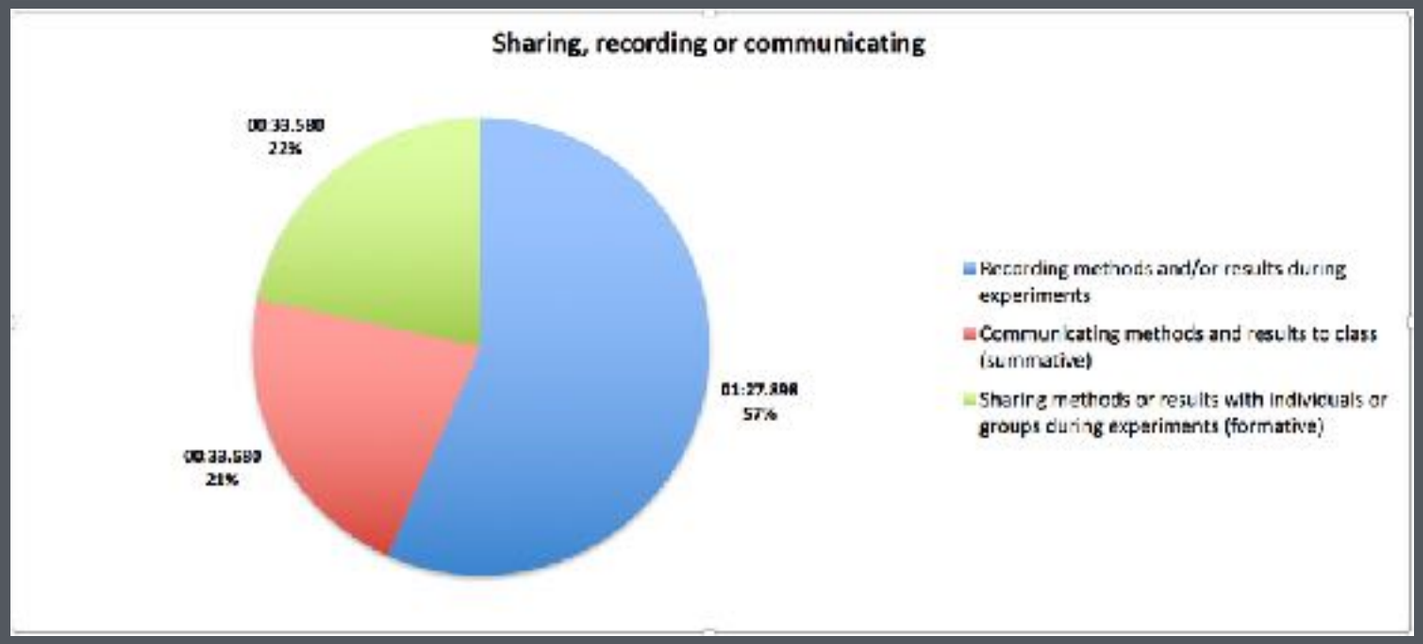
- before experiment
- during experiment
- after experiment (what went wrong? making changes)

Sharing, recording, communicating

- recording results
- sharing with others during experiments
- communicating methods & results at plenaries







Students' use of scaffolds

Seamlessly integrated with practical work. Students made deliberate decisions to use scaffolds based on their needs at the time

- For mirroring methods
- As reflective prompts (where did we go wrong? why are our results different?)
- As 'foils' for group discussion (reflection, analysis and evaluation, variables)
- For timely formative feedback
- For helping understand 'the science behind the experiment'
- For efficiently sharing and communicating methods and results

What was learnt about the design of scaffolds?

• Text-based conceptual scaffolds were infrequently accessed and viewed by students as inaccessible. Differently designed scaffolds needed for presenting conceptual information

• Silent videos prompted group discussion and triggered higher order thinking such as interpretation, reflection, analysis and evaluation (*having less information was more effective*)

• Student control. 'Stepping' videos, replaying video segments, checking and comparing, formative - information 'on tap')

• Seamless integration supported sharing, communicating & concept development (in class and beyond). Camera & video record and export, Apple TV, Edmodo, Facebook

Considerations for practice

The blend of learning design and digital resources supported the school's competency framework and teachers' learning goals, to a point. It supported students' thinking, communication and self-regulation competencies, however…

- app scaffolds were generally ineffective for conceptual learning. Plenary sessions were essential for learning 'correct' science
- teachers needed a firm grounding in the science to satisfactorily facilitate concept-building *formatively* during workshops and *summatively* in plenaries ('doing their homework')
- careful scrutiny and selection of apps and planning for use (compatible with pedagogy and learning design to support *seamless* integration)
- robust technical infrastructure needed

Considerations for app developers

- understand the learning preferences and characteristics of target audience/s

- understand the nature of curriculum and learning designs within which the apps will be used.

- understand curriculum competency objectives

- field-test prototypes - collect and analyse data on user interaction

- incorporate accessible conceptual scaffold options

- understand that providing *less* information can be *more* effective for supporting learning

Thank you for attending and do you have any questions?

THE UNIVERSITY OF WAIKATO
Te Whare Wānanga o Waikato