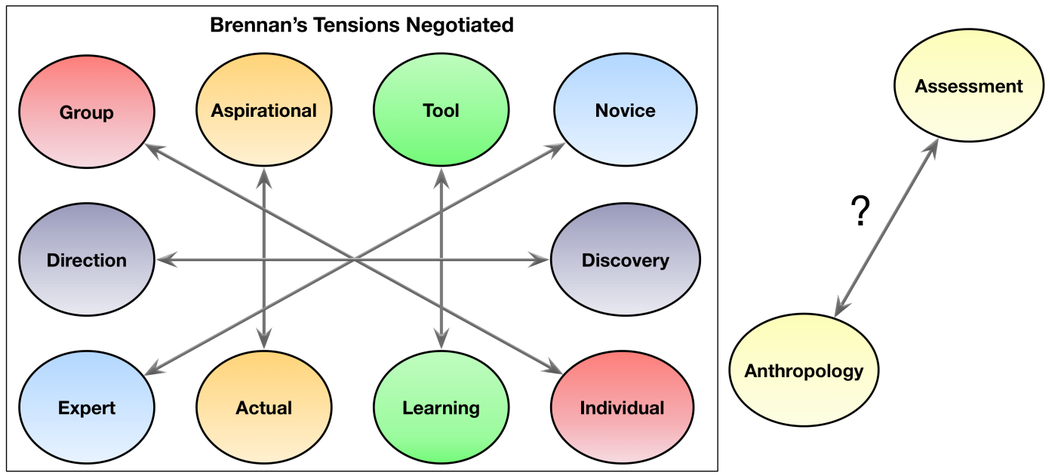
To Assess or Not to Assess: Tensions Negotiated in Six Years of Teaching Teachers About Computational Thinking



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Professional Development (PD) for Coding

- Teacher preparation for Coding is a global challenge
- There is a variety of Professional Development (PD) that has been developed and researched to address this challenge
- *MOOCs*, *face-to-face workshops* and *graduate certificates*[1]
- Some models involve *Constructionist learning experiences* and combine face-to-face workshops and online (e.g. ScratchEd[2])

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[1] **http://edutech.educ.msu.edu/programs/certificate/k12csed/**

[2] **http://scratched.gse.harvard.edu/**

Our Professional Development Design

- We have run face-to-face PD workshops since 2013 (1-2 a year)
- Typically run over 2 days with K-6 and 7-12 separate
- Funded through *Google CS Educator PD Grants* (formerly CS4HS)
- Run with Constructionism as a *framework for action*[3]
- Studying and improving this PD became part of my PhD project
- We have recently run two Coding PD programs over a school term[4]

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[3] DiSessa, A. A., & Cobb, P. (2004). Ontological innovation and the role of theory in design experiments

[4] **cs4s.github.io/2018/maths/** and **cs4s.github.io/2018/steam/**

Content Knowledge and Pedagogical Content Knowledge

- *Content Knowledge (CK)* is essential for teaching Coding and CT
- *Pedagogical Content Knowledge (PCK)* is also important
- Our knowledge of *Pedagogical Content Knowledge* specific to Computer Science (*CS-PCK*) is in its infancy[5]
- There are many lessons to be learned about imparting *CK* and *PCK* through PD

[5] Cooper, S., Grover, S., Guzdial, M., & Simon, B. (2014). A future for computing education research

Lessons Learned and Tensions Negotiated

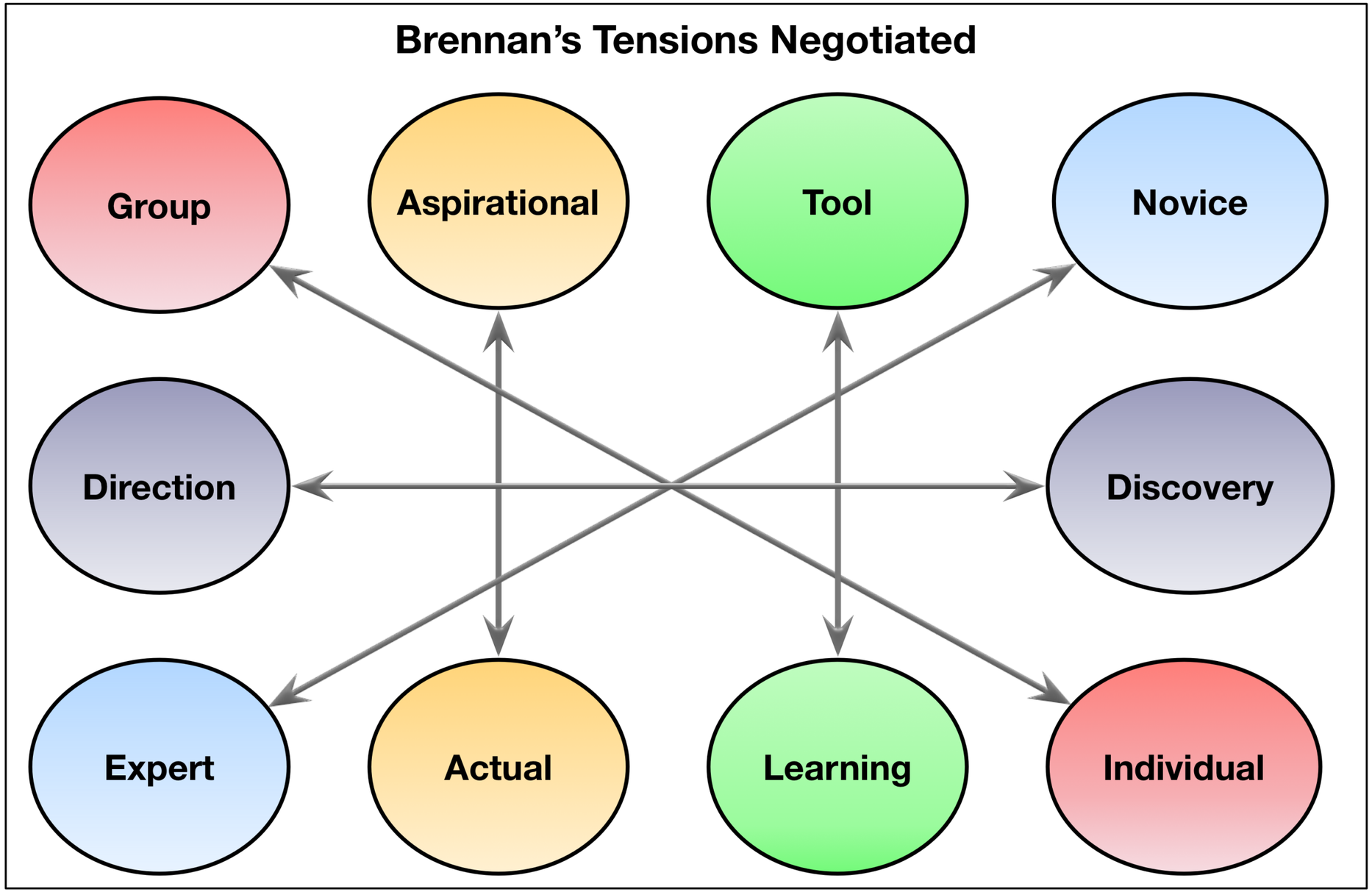
- Karen Brennan wrote article titled **Beyond Technocentrism** about the *ScratchEd* PD model in special issue on 'Constructionism and Creativity' of the journal *Constructivist Foundations*[6]
- In this article, she reflects: *"I am often asked 'What lessons have you learned from your [PD] work?' I have to appreciate that my experiences and understandings are more aptly described as 'tensions negotiated' than 'lessons learned'"*

[6] Brennan, K. (2015). Beyond Technocentrism: Supporting Constructionism in the Classroom

Tensions Negotiated in our PD

- Brennan identifies 5 sets of tensions (e.g. the tension between direction and discovery) she considers the most pressing
- These could help *"conversations and questions about how to support constructivist/constructionist approaches in classrooms"*[6]
- Our lessons learned are more like *tensions negotiated*
- Analysed our survey responses from six years (n=137) and coded these using the tensions identified by Brennan as a lens

[6] Brennan, K. (2015). Beyond Technocentrism: Supporting Constructionism in the Classroom


Brennan's Tensions Negotiated
Group
Aspirational
Tool
Novice
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Individual

Brennan's Tensions Negotiated as a Lens

- Recently, we have had the opportunity to reflect on our workshops and consider the tensions in designing and implementing this PD
- Brennan notes that these sets of tensions could be *"a general model for PD designers to scrutinize and critique"*[6]
- I will explain three of tensions (the rest are in the paper) identified by Brennan, how we have experienced them and how they have influenced the design of our PD

[6] Brennan, K. (2015). Beyond Technocentrism: Supporting Constructionism in the Classroom

Tension between Tool and Learning

- Brennan negotiates between a focus on *Tool* and *Learning*:
  - *Tool:* a particular tool (Scratch) or CT concepts, aka the *Content Knowledge (CK)*
  - *Learning:* pedagogical practices (e.g. creative design activities) aka *Pedagogical Knowledge (PK)*
- *ScratchEd* model emphasises *PK* (particularly *creative design activities*) over *CK* but there always has to be a balance

Tension between Tool and Learning

- We have typically focused on imparting *CK* in our PD
- Often teachers come to our PD with no *CK* and low confidence
- Now have combination of sessions which focus on *CK* and *PCK*
- Naming of sessions (*Creative Computing with Scratch*), with incluson of creative design activities, e.g. from the **Creative Computing Curriculum Guide**[7]

[7] **http://scratched.gse.harvard.edu/guide/**

Tension between Direction and Discovery

- This set of tensions involves instructors balancing:
  - *Direction:* providing guidance and "steering learner needs"
  - *Discovery:* allowing teachers to choose their own learning goals and encouraging self-directed learning
- Similar to the "play paradox" defined by Noss and Hoyles[8] (balancing exploration and guidance in a microworld like Logo)

[8] Noss, R., & Hoyles, C. (1996). Windows on mathematical meanings: Learning cultures and computers

Tension between Direction and Discovery

- Our PD has been run with a main goal to help upskill teachers
- Have to impart certain *computational concepts*[9]
- One of main assumptions of *ScratchEd* is that *"teachers should have learning experiences that are comparable to their students' learning experiences"*[6]
- We have the same view for our own PD

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[9] Brennan, K., & Resnick, M. (2012). New frameworks for studying and assessing the development of computational thinking

[6] Brennan, K. (2015). Beyond Technocentrism: Supporting Constructionism in the Classroom

Tension between Direction and Discovery

- Inclusion of activities that balance *direction* and *discovery*
  - 10 Blocks activity for the *Creative Computing Guide*
  - *ScratchMaths* Investigations and Challenges
- Ran long-term PD which included small homework projects
  - *"Whenever two sprites collide, one of them says: 'Excuse me!'"*
- We try to have choices of activities and/or parallel sessions
- We also encourage teachers to seek out different resources

Tension between Actual and Aspirational

- *Actual:* "the lived reality of K-12 education"[6] (lack of time etc)
- *Aspirational:* an 'ideal' Constructionist learning environment
- Brennan[6] states that: *"In many ways, constructionist learning experiences are fundamentally at odds with the lived reality of K-12 education"*
- In our context, that is not 100% true

[6] Brennan, K. (2015). Beyond Technocentrism: Supporting Constructionism in the Classroom

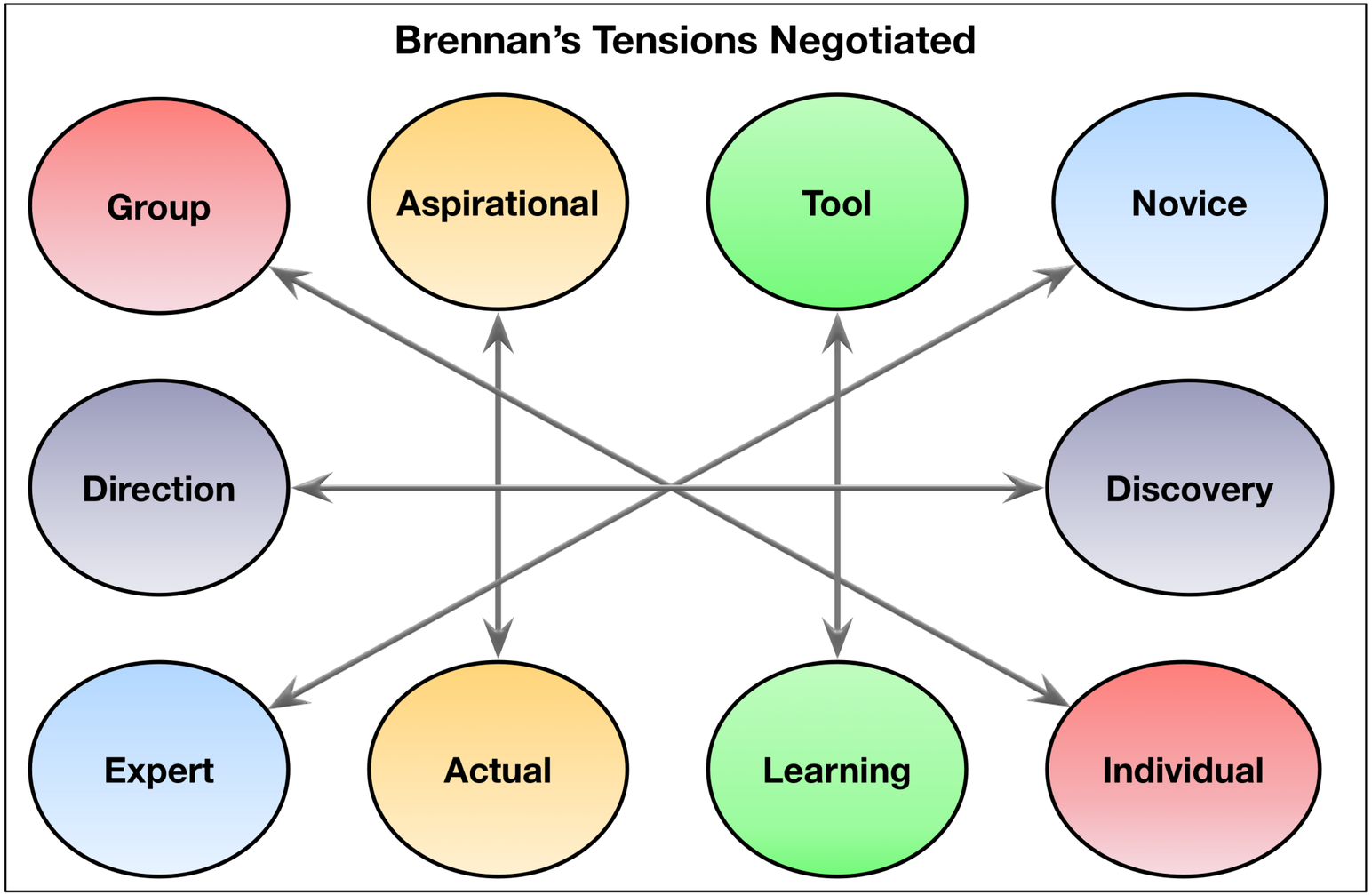
Tension between Actual and Aspirational

- *"Designing, making, data collection and analysis"* are part of our state's Science and Technology subject
- Similarly, *General Capabilities* (e.g. *Creativity*) can be addressed through design activities
- We tend to focus on the *actual* (partly due to feedback)
- Current consensus about sustained impact of PD: aligned to school needs & involves collaboration with school administration[11]

[11] Desimone, L. M. (2009). Improving Impact Studies of Teachers' Professional Development: Toward Better Conceptualizations and Measures

Tension between Actual and Aspirational

- The curriculum is considered to be overcrowded already
- Our local education authority is encouraging teachers to integrate Coding across subjects (my PhD research looks at how Year 5 & 6 teachers do this)
- To address this tension we have designed and implemented PD that involves integration with existing K-12 subjects (*ScratchMaths* and *Networks*)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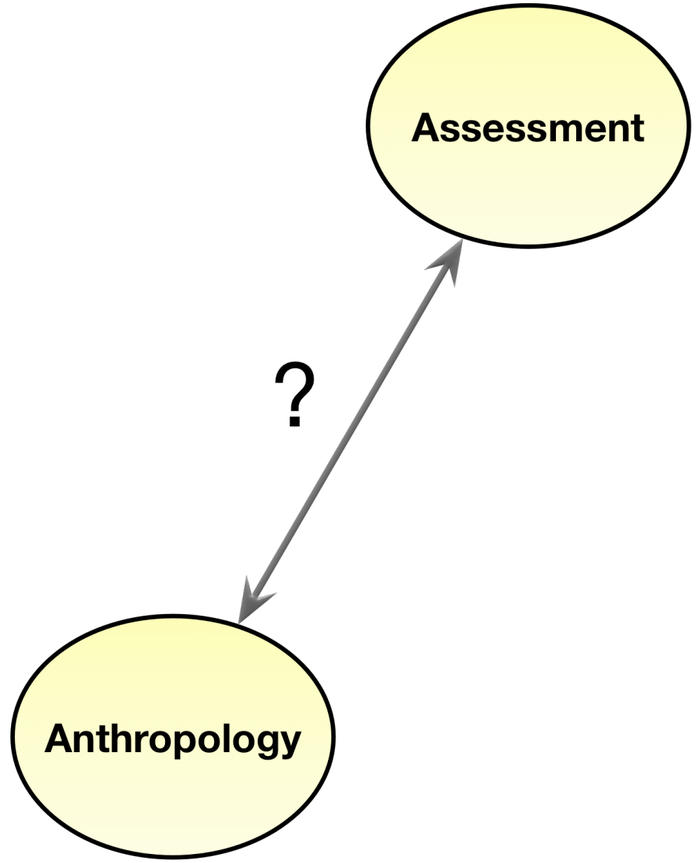
Assessment
?
Anthropology

Tension between Anthropology and Assessment

- We identified another tension that we find pressing in our work, with respect to understanding impact of our PD
- We call this the tension between *anthropology* and *assessment*
- *anthropology:* named according to claim by Papert that *"The educator must be an anthropologist"*[12]
- *assessment:* measuring participants' (**teachers**') understanding with quantitative measures

[12] Papert, S. (1980). Mindstorms: Children, computers, and powerful ideas

Tension between Anthropology and Assessment

- Brennan does not mention a similar tension in her article[6]
- This could be because of different format of *ScratchEd*
- Does state that there is a *"lack of meaningful metrics"*
- We contend that there are meaningful measures (for *CK* and *PCK*)
- There is a recognised need for these measures and a lot of recent work in Computing Education Research community in this area (e.g. Bebras, CAS Project Quantum)

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[6] Brennan, K. (2015). Beyond Technocentrism: Supporting Constructionism in the Classroom

Tension between Anthropology and Assessment

- In our PD, we have to plan the essential learning outcomes
- Discussions specific to this can be found in the *Social Shaping of Logo*[13] & *Windows on Mathematical Meanings*[8]
- We have used self-reported measures & feedback in the past
- We believe that the next step for us is to evaluate the PD with more rigorous measures

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[13] Agalianos, A., Whitty, G., & Noss, R. (2006). The Social Shaping of Logo.

[8] Noss, R., & Hoyles, C. (1996). Windows on mathematical meanings: Learning cultures and computers

Tension between Anthropology and Assessment

- Two main reasons to start more rigorous evaluation in our PD
- First, we need to know that teachers have learned & whether the PD has had a positive effect
- Second, there is likely to be a push for evidence from government and funding bodies as they want to know the impact of PD
- We plan to address this tension in future PD and have trialled some assessment of *computational concepts*[9] in recent PD

[9] Brennan, K., & Resnick, M. (2012). New frameworks for studying and assessing the development of computational thinking

Applying the Tensions Negotiated

- Brennan's *'tensions negotiated'* are useful as a framework for reflecting on our experiences (we experienced them all)
- Applied recently in the design of two PD programs (a term-long program and 2-day workshop)
- Interestingly, some teachers discuss similar issues of balance in their feedback

Feedback

- *"The balance between explicit teaching, individual work and collaborative work was really good."* - Principal (30 years)
- *"I really loved the balance between lessons (content, instructional) and the opportunity to try ourselves and even go off on little tangents/try new things."* - Classroom Teacher (20 years)
- *"All the sessions were incredibly well sequenced and structured... Allowing us to tinker with each program taught about was also incredibly powerful"* - Classroom Teacher (recent graduate)

Further Research and Wrap-up

- Intend to reflect on the 'tensions negotiated' when planning and implementing future PD design (e.g. Coding Hubs)
- Compulsory Informatics/CS K-12 education may allow for more research into impact of PD (e.g. ScratchMaths evaluation)
- We plan to address the *tension between anthropology and assessment* in future PD through testing and development of measures of *CK* and *PCK*
- Have you experienced these tensions in your own work?