OOF | TAS COLLECTIVE

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Designing professional development to empower out-of-field teachers: Insights from Israel

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Setting: The Israeli education system

- The education system in Israel consists of three tiers:

  1. Primary education (grades 1–6, ages 6-12)
  2. Middle school (grades 7–9) → Less tracking → Directing students' choice of elective subjects in high school (e.g., Biology, Physics, Language, Art..).
  3. High school (grades 10–12) → More tracking → Preparing students for final matriculation exams.

- Centralized education system: The Ministry of Education determines educational policy, curricula and assessment via matriculation exams. It sets schools' budget and employs the teachers.

- The matriculation certificate and scores determine acceptance into higher education.

(OECD, 2016)

The challenge: more physics learners with few physics teachers

- The Israeli economy is science and technology oriented, high demand for scientists and engineers.
  - ➔ Government policy: encourage students' choice of physics as a high-school elective.
  - ➔ Tracking - creating excellence tracks specializing in physics and technology for ~30% of middle school students (on top of the integrated science course for all).

- The school principals fall short in implementing the government policy as the salaries of teachers (public sector) are much lower than those of engineers (private sector).

Outcome: > 50% of physics teachers in middle school, including in the excellence tracks, are out of field.

The opportunity: an infrastructure for disciplinary professional development

- Disciplinary Professional Development (PD) frameworks are built into the Israeli education system:
  - Teachers: Salary benefits aligned with accumulation of PD courses.
  - PD providers: Public and private funding for professional learning communities.
  - School principals: PD takes place after school hours, no need for substitutes.

- We focus on a professional development framework for teachers who teach physics in excellence tracks - both out of field (OOF) and in field.

What we learn from the literature: pitfalls in PD programs for OOF teachers

- OOF teachers participate less in PD - either because policymakers view their situation as temporary (not worth investing in), or because the teachers are not motivated.
- Commonly, PD programs for OOF teachers focus strongly on content-knowledge and incorporate some PCK aspects.
- OOF teachers often participate together with in-field teachers in 'one-size-fits-all' programs - making the OOF teachers uncomfortable to express themselves or ask questions.

➔ The teachers are in a degraded position. Their prior knowledge and expertise are not valued.

(Du-Plessis et al., 2015; Faulkner et al., 2019)

What we learn from the literature: Design principles for the PD of OOF teachers

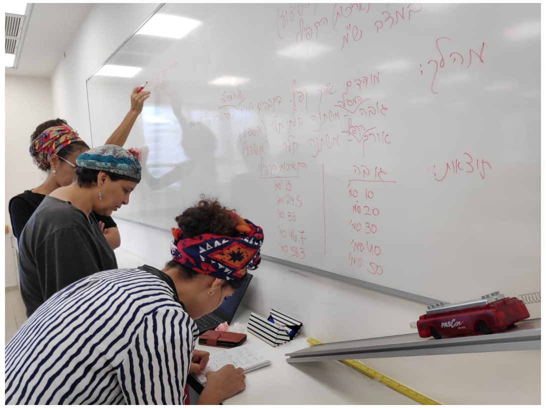
- Situated perspective: PD should be anchored in ongoing practice and involve collaborative reflection on practice (Putnam & Borko, 2000).

- Constructivist perspective: Prior knowledge should be treated as a productive resource:

We focus on the disciplinary resources that OOF teachers bring from their original disciplines and tailor the PD activities so they can serve them in their new teaching field.

Putting principles into practice: The *Gateway to physics program*

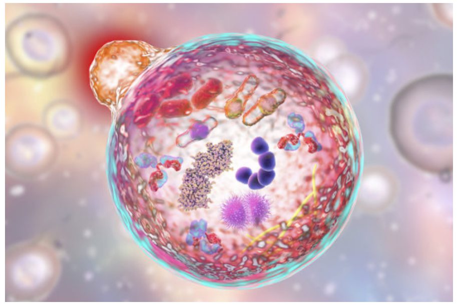
- A network of disciplinary learning communities
  (~5 each year, since 2018, >300 teachers).
- Most OOF participants have a background in biology.
- PD activities encourage OOF teachers to draw on their resources:
  - Familiar contexts: to the biology teachers (e.g., particle model, experimental design).
  - Dialogic argumentation: structuring opportunities for dialogues between OOF and in-field teachers, expressing their respective perspectives.
  - Participants experience the inquiry-oriented modules as leaners, discuss underlying pedagogy and engage in structured cycles of reflection on practice - teachers share and discuss dilemmas in implementation (Yerushalmi & Eylon, 2013).

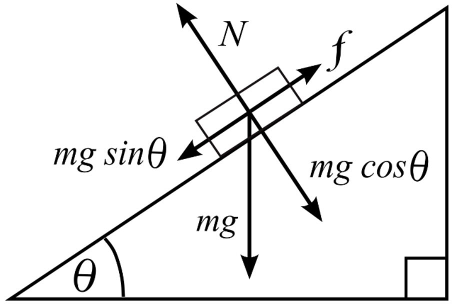


Bridging the disciplinary gap between school physics and biology

The scientific disciplines differs in the systems investigated as well as the practices used to investigate and construct scientific knowledge.

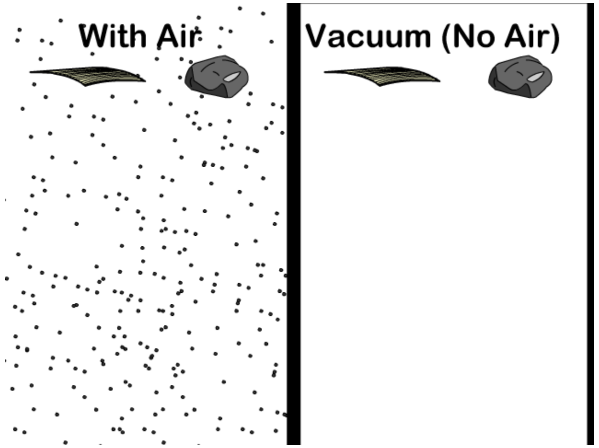
School Biology:
complex, many particle systems
=>
qualitative, descriptive reasoning.





School Physics:
Simplified systems (1-2 objects)
=>
Qualitative reasoning, based on theoretical models.

Falling through air:
complex, real-life context
Invites empirical reasoning
and particle level explanations



Free-fall:
Simplified context
invites confirmation of
theory-based equations

(Knorr-Cetina, 1999; Redish and Cooke, 2013)

What kind of research are we conducting in this context?

The aim of our research is to examine how, if at all, this approach serves the teachers:
do they manage to build on their former resources? How does their learning process look like?

Data collection and analysis includes:

1. **Documentation of teachers' discourse in the PD activities:**

   We use discourse analysis to examine the type of discourse the teachers are engaged in (specifically looking for deliberative argumentation), power relations among them and the epistemic practices enacted in the discourse.

2. **Teachers' reports on classroom activity** (structured reflection on practice):

   We use the *boundary crossing* framework to examine the characteristics of the inquiry activities the OOF teachers report conducting in their physics classes, the boundaries they faced and resources that enabled their crossing.

(Perl-Nussbaum et al., 2023; Yerushalmi et al., 2023)

Samples from our findings

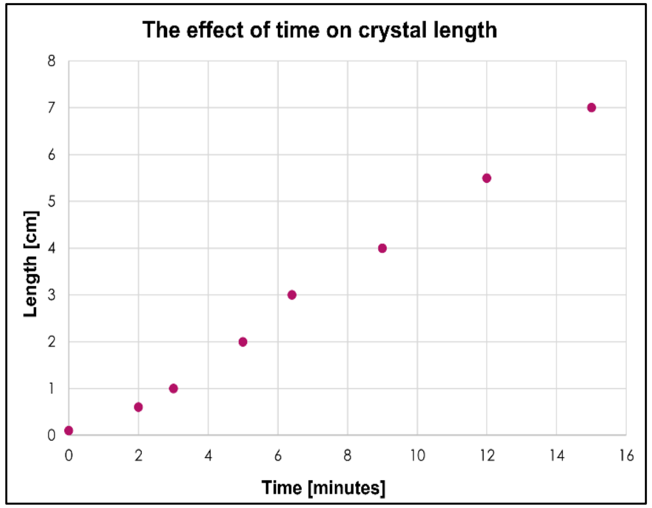
The chemical garden case (Delilah)

Familiar OOF resources

Delilah Presented a classroom investigation of crystal growth:

- Popular in the integrated curriculum.
- Qualitative demonstration, 3D, colorful, “wow” effect.

PD resources - physics



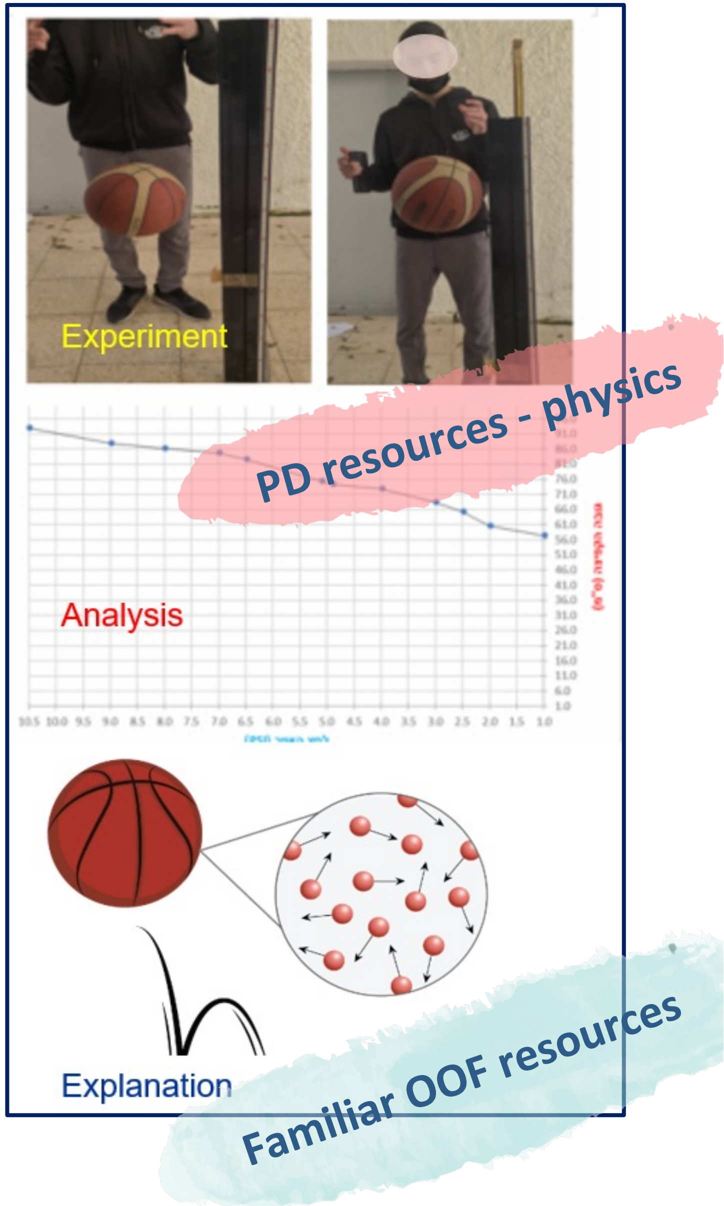
Delilah added mathematical modeling practices:

- Simplification to 1D phenomenon, grown in a tube.
- Quantitative modeling of growth over time.

Samples from our findings

The bouncing ball case (Gail)

"I am very proud of this project. I overcame my fears and succeeded in guiding an inquiry project in physics. I even chose this project to represent the school in the municipal science fair."



Discussion

- Recently, researchers have begun to portray effective features for the professional development of OOF teachers, emphasizing the importance of attending to identity and motivation, and providing ongoing support to meet teachers' unique challenges.
- Our PD approach builds on teachers' prior disciplinary resources and provides design guidelines that enable them to integrate these resources into their physics instruction.
- This approach, (and more positive approaches towards OOF teaching overall) requires some "flexibility" of disciplinary boundaries - a more interdisciplinary approach to learning.
- In our context, biology teachers have knowledge and practices that contribute to physics learning. Can this approach be applied to other subjects? We believe so, provided the differences and connections between disciplines are mapped.

Thank you for listening!

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Questions?

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