Opening Pathways into Engineering Through Illinois Physics and Secondary Schools (IPaSS) Partnership

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DRL-K12 #2010188

IPaSS Program Overview

Description and Goals

The Illinois Physics and Secondary Schools (IPaSS) Partnership Program is a four-year Early-Stage Design and Development project. IPaSS aims to open pathways for students into engineering by partnering with Illinois high school physics teachers in pursuit of three overarching goals:

(1) Delivering an award-winning, flipped-style, lab-based university curriculum to high school students;
(2) Acting as a university partner to support high school teachers' implementation of this coursework using a Community of Practice (CoP) model and prolonged professional development (PD);
(3) Sustaining and expanding this program by supporting growth of teacher leaders and mentors within the CoP.

Using a cohort-based model, IPaSS is currently supporting 40 teachers from 38 schools. 60% of IPaSS-affiliated public schools are Schoolwide Title 1 eligible (>40% students low-income).

4 Teachers → 14 Teachers → 24 Teachers → 40 Teachers

Introducing University-level Curricula

IPaSS was developed and university level curricula were introduced to teachers in response to three well-documented challenges in physics education.

1. The increase in enrollment in high school physics courses over the past two decades in the United States has presented a challenge for secondary schools in staffing physics courses.
2. Physics teacher disciplinary under-qualification, overextension of physics teachers to teach numerous other courses, and the isolation of physics teachers in many schools.
3. The need for high-quality instructional materials to support a wider range of student abilities (after changing AP physics B to 1 and 2 based on NRC recommendations).

Figure 1. SmartIllinois (an online platform for delivering physics content) and iOLab (a multi-sensor lab device) developed by PI and other faculties in U of I were introduced to IPaSS teachers to develop high school curricula.

Responsive Professional Development (RPD) in CoP

Responsivity is conceptualized as being *attentive* to teachers needs and emergent interests and *adaptive* in PD instructions which was a facilitation model in running IPaSS PDs.

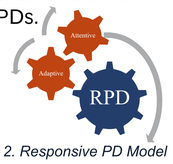

Figure 2. Responsive PD Model

- Interview and open-ended surveys from 13 teachers showed that responsive PD can facilitate teachers' transition from peripheral to more active roles in CoP.

Responsive Moves

- Intentional but adaptive teacher groupings supported peripheral members' integration of new pedagogies.
- Adapting program foci around teachers' needs ensured practicality and flexibility.
- Being attentive to teachers' needs facilitated serving teachers with diverse teaching backgrounds.
- Being responsive to teachers' desire to share through creating ongoing opportunities for share-out.
- New workshop installations responded to teachers' immediate needs.

Salient Features of the Program from Teachers' Standpoint

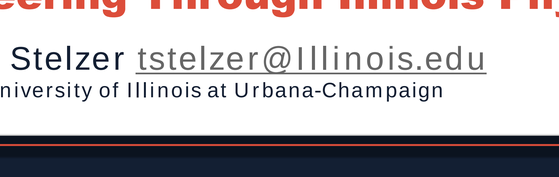

Figure 3. IPaSS Teachers' Perceptions of the Salient Features of the Program.

IPaSS is changing everything. It has helped me out with lab ideas, given me great ideas to get the kids to start talking and interacting, recommended great books to read, and introduced me to new planning cycles.
Meetings are great at calming me down when a week has gone badly.

-Carla, Cohort 2

Implementing Open-ended Labs

Despite many teachers acknowledging the importance of open-ended labs, implementing them in high-school physics classes has proven to be challenging, primarily due to structural issues (e.g., time and access to lab materials) and instructional support. Surveys and PD videos revealed three significant barriers to implementing open-ended labs in physics classrooms for IPaSS teachers.

- Structural Constraints (e.g., time and populous classes)
- Teachers' Perceptions of Students' Abilities
- Teachers' Perceptions of their own Content and Technological Abilities

However, further analysis revealed the impact of community in changing some of these perceptions which resulted in change in their teaching practices.

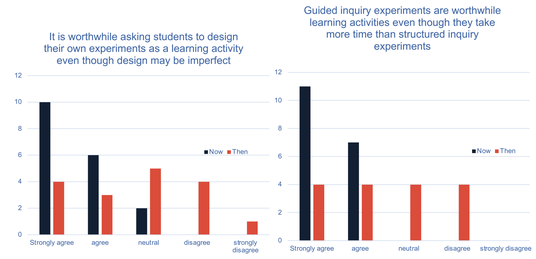

Figure 4 (a-d). Examples of retrospective survey from returning teachers that shows how their perceptions about implementing open-ended labs has changed.

Teachers Co-designing Labs during Summer PDs

Teachers Introducing New Pedagogies in Teaching Physics

While sharing university curricula, the program encourages teachers to introduce new pedagogies, resources and ideas to the group. Using a responsive model for facilitating professional development, the program responded to teachers' desires to share either their adaptation of university materials or other pedagogical ideas. Many of these ideas are research-backed in physics classrooms but have not been implemented in PD contexts. A few examples are:

- Whiteboard Speed-dating with goalless problems
- Card-sorting
- Gamification in teaching physics
- Vertical whiteboarding

Figure 5. Vertical Whiteboarding

Figure 6. Card sorting Activity

Broader Impact

Among the 24 schools affiliated with IPaSS through its third year, 20% created or were approved to create new AP physics courses. Given the administrative obstacles associated with developing and teaching advanced physics courses, IPaSS's track-record of promoting advanced physics course development in new settings across the state has been impressive. Partnerships modeled after IPaSS may be able to similarly bring high-quality, advanced physics courses to schools who have historically struggled to offer physics at all.

IPaSS Team

Disclaimer: This project is funded by the National Science Foundation, grant # 2010188. Any opinions, findings, and conclusions or recommendations expressed in these materials are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

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