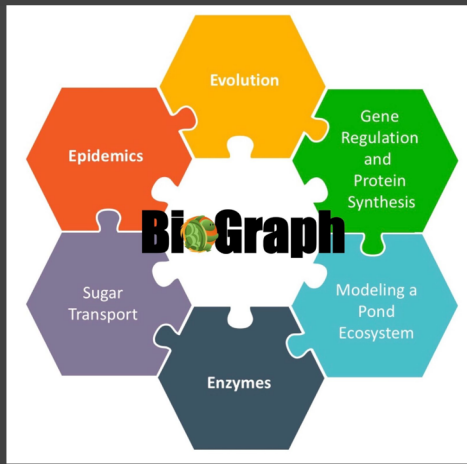


BioGraph 2.0:

Online Professional Development
for High School Biology Teachers
for Teaching and Learning about
Complex Systems

Presenter: Katherine Miller, Project Manager, UPenn
PI: Dr. Susan Yoon, UPenn
Co-PI: Dr. Eric Klopfer, MIT





BioGraph: Teaching Biology Through Systems, Models, and Argumentation

A brief video introduction to the BioGraph project through the words of teachers who have participated in the PD.

[CLICK HERE TO PLAY](#)

Or view video in session file uploads.

BIOGRAPH 2.0



STARLOGO
NOVA



Scheller Teacher Education Program
education arcade



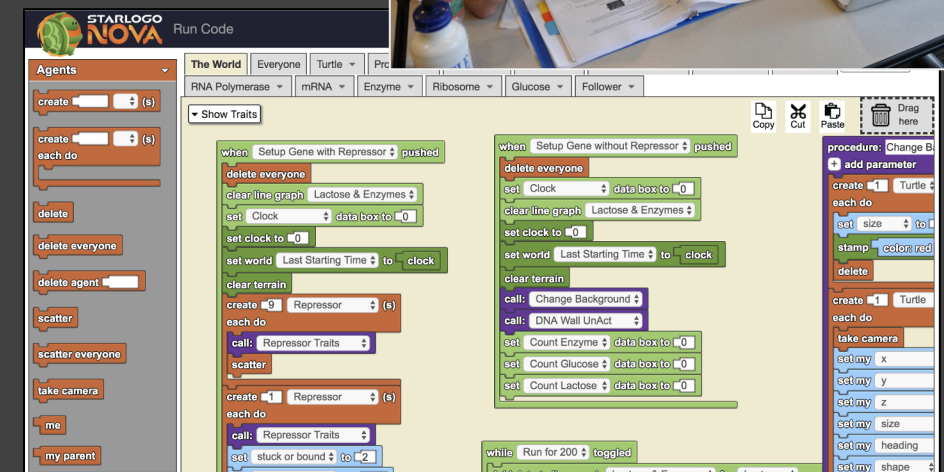
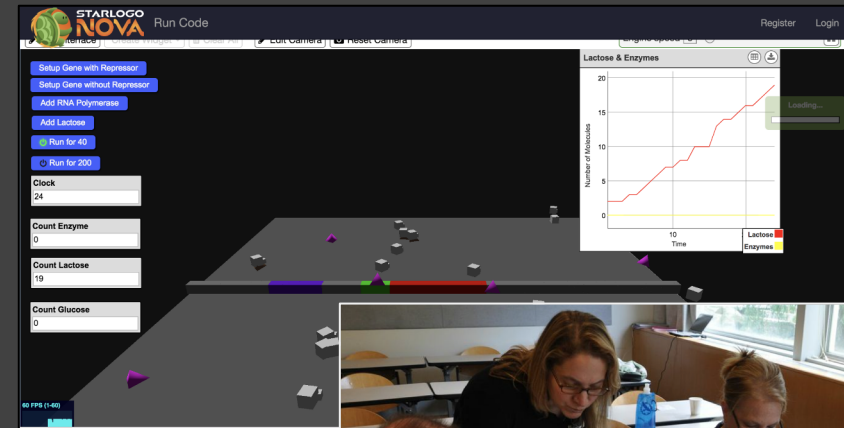
Graduate School of Education
Penn GSE

Designing for Face-to-Face: BioGraph 1.0 (2010 to 2015)

The current project, BioGraph 2.0, extended and scaled up a previous project.

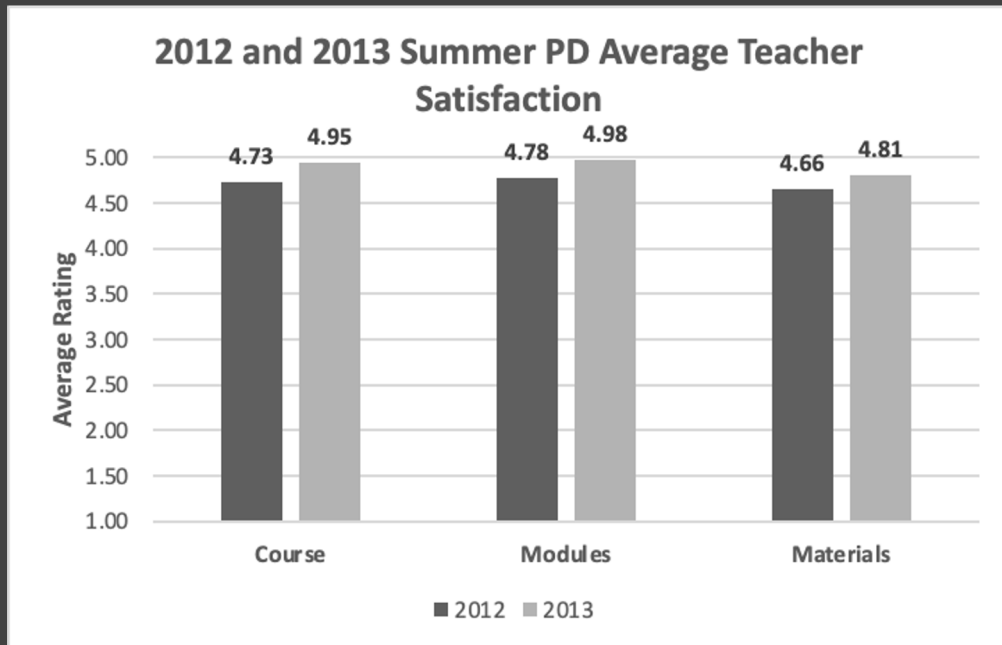
The first NSF grant for BioGraph 1.0 (DRL #1721003) was for a face-to-face PD.

- The PD extended across 2 years
- Included extensive training in content knowledge and pedagogical content knowledge
- Teachers were co-designers of the curriculum
- Ongoing reflection and feedback
- Year 2 focused on building Social capital



Sample BioGraph 1.0 Outcomes

Teacher satisfaction with the PD as measured across three categories through end-of-PD surveys



Student outcomes as measured by pre and post implementation surveys that measured both content knowledge and classroom experience.

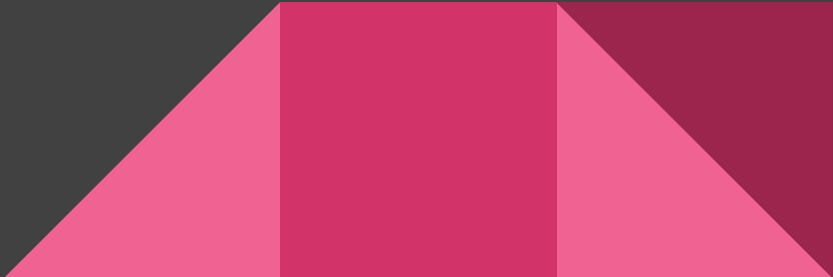
Iteration	<i>t</i> value	<i>df</i>	<i>p</i> value	Cohen's <i>d</i>	
1.1	10.73	362	< 0.001	0.56	Biology Content
1.2	12.50	345	< 0.001	0.67	
Iteration	<i>t</i> value	<i>df</i>	<i>p</i> value	Cohen's <i>d</i>	Complex Systems Content
1.1	3.51	353	< 0.001	0.19	
1.2	12.26	360	< 0.001	0.65	
Iteration	<i>t</i> value	<i>df</i>	<i>p</i> value	Cohen's <i>d</i>	Classroom Experiences
1.1	6.86	320	< 0.001	0.36	
1.2	11.54	309	< 0.001	0.67	

For Further information about BioGraph 1.0 see the following Sample Publications

Yoon, S. (2018). Mechanisms that couple intentional network rewiring and teacher learning to develop teachers' social capital for implementing computer-supported complex systems curricula. In S. Yoon & K. Baker-Doyle (Eds.), *Networked by design: Interventions for teachers to develop social capital* (pp. 7-23). New York, NY: Routledge Press.

Yoon, S., Anderson, E., Koehler-Yom, Evans, C., Park, M., J., Sheldon, J., Schoenfeld, I., Wendel, D., Scheintaub, H., & Klopfer, E. (2017). Teaching about complex systems is no simple matter: Building effective professional development for computer-supported complex systems instruction. *Instructional Science*, 45(1), 99–121.

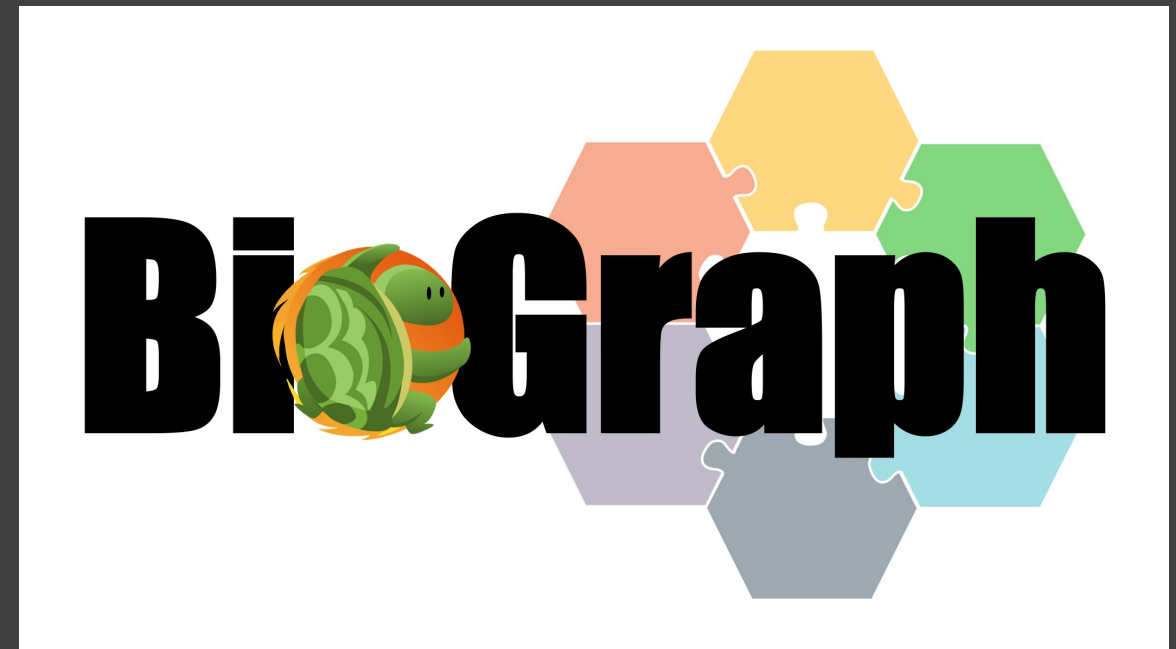
Yoon, S., Klopfer, E., Anderson, E., Koehler-Yom, J., Sheldon, J., Schoenfeld, I., Wendel, D., Scheintaub, H., Oztok, M., Evans, C., & Goh, S. (2016). Designing computer-supported complex systems curricula for the Next Generation Science Standards in high school science classrooms. *Systems*, 4(38), 1–18.



BioGraph 2.0: Moving Online (2015 to present)

The success of BioGraph 1.0 prompted a desire to expand the reach of the program and make it accessible to a wider range of teachers.

- Traditional face-to-face PD is expensive to implement (TNTP, 2015)
- PD online can be as successful as face-to-face (Fishman et al., 2013)
- Online PD benefits geographically isolated teachers (Peltola et al., 2017)
- Enables more and flexible time to participate in PD (Merritt, 2016)
- Teachers take MOOCs! (Ho et al., 2015)



Developing Social Capital in Online PD

Enabling collaboration and social interaction in an asynchronous online learning space is difficult (Alterman & Harsh, 2017; Booth, 2012; Kop, 2011). The BioGraph project seeks to build both human capital and social capital.

Human Capital: Resources that are acquired by an individual in terms of skills, knowledge, and experiences to accomplish a task.

Social Capital: Resources that are acquired through direct or indirect relationships in social networks to accomplish a task.

Designing for Social Capital in Online PD

Social Capital Characteristics	Design Strategies
Tie Quality	Online profiles; collaborative prompts; 6-week summer PD on edX; extended school year
Trust	Synchronous meetups; public sharing through content and implementation prompts;
Depth of Interactions	Demonstration videos; problems of practice; embedding in standard curriculum; group capstone activities
Access to Expertise	Expert classroom instruction videos; expert teachers as course facilitators; FB; WhatsApp; Moodle

Sample Design Features of BioGraph 2.0

- Teachers from BioGraph 1.0 served as design collaborators
- Example videos of expert classroom implementation
- Focus on common problems of practice
- Access to peer experts as PD facilitators during the course
- Prompts for reflection on practice
- Whole group discussions within course discussion forums

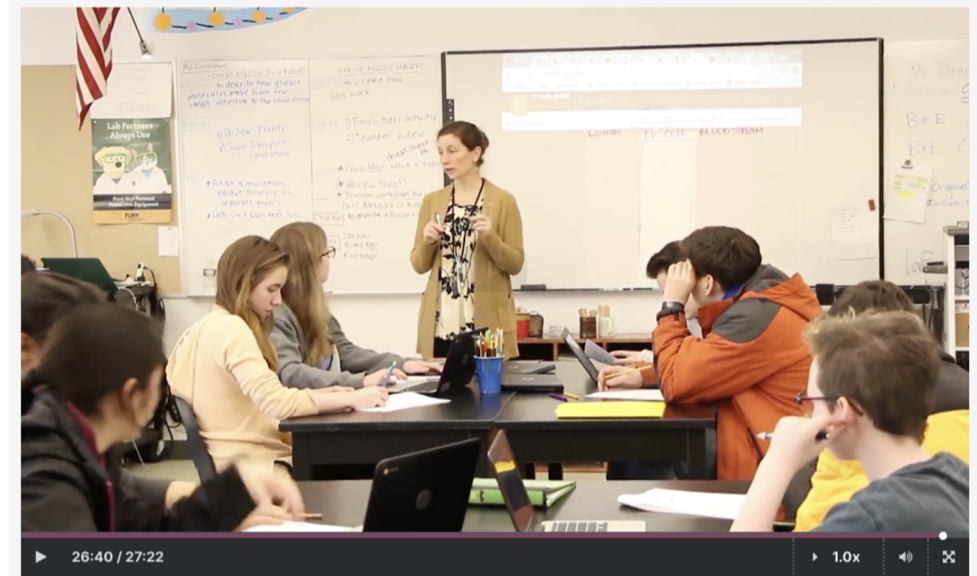
6.3.3a Observing an Implementation: Sugar Transport - Day 1

Bookmark this page

Let's listen to Emma, one of our expert teachers, as she highlights some of the things that she hopes to accomplish as she implements Sugar Transport. Then, watch as she facilitates the first day of the lesson.

STAFF DEBUG INFO

Sugar Transport - Implementation Day 1



STAFF DEBUG INFO

PROBLEMS OF PRACTICE: FACILITATING SCIENTIFIC PRACTICES AND CROSS-CUTTING CONCEPTS

In the practice of scientific modeling, there is no 'right way' to represent a concept. Different models are useful for different things, depending on the assumptions and details built into the model. Now that you've watched the first day of Emma's class implementation of Sugar Transport, think about how Emma demonstrates to her students that models are tools for questioning and understanding concepts, rather than singular representations of conclusive truth and discuss in the Forum below.

Discussion Forum: Sugar - Scientific Practices

Emma uses multiple models to represent the same phenomenon here. How could this activity be used to support students in understanding that "all models are wrong but some models are useful"?

STAFF DEBUG INFO

Participants Across the Years

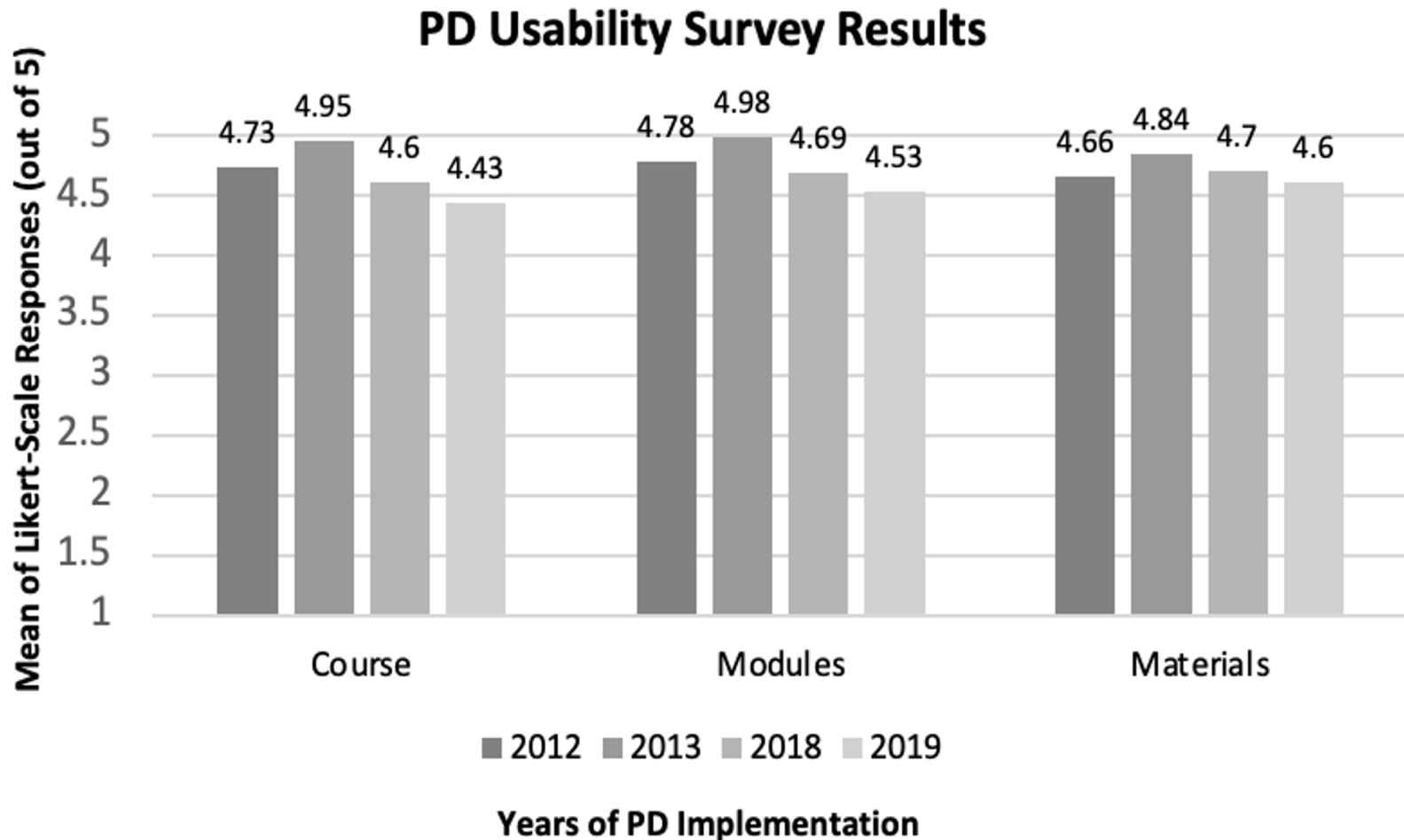
Course enrollment and completion for the online edX PD

Year (Cohort)	Enrollment Stats	Completion Stats
2018 (2.1)	7 from 2 US states	7 from 2 US states
2019 (2.2)	379 from 11 US states and 23 countries	39 from 9 US states and 6 countries
2020 (2.3)	1462 from 21 US states and 95 countries	74 from 13 US states and 14 countries
2021 (2.4)	589 so far from 78 countries	Will finish in September 2021

Teacher and student participation in school year extended research

Year (Cohort)	Teacher Stats	Student Stats
2018 (2.1)	5 teachers from 2 US states	88 students from 4 schools
2019 (2.2)	7 teachers from 2 US states and two schools in India	212 students from 3 US schools and two schools in India

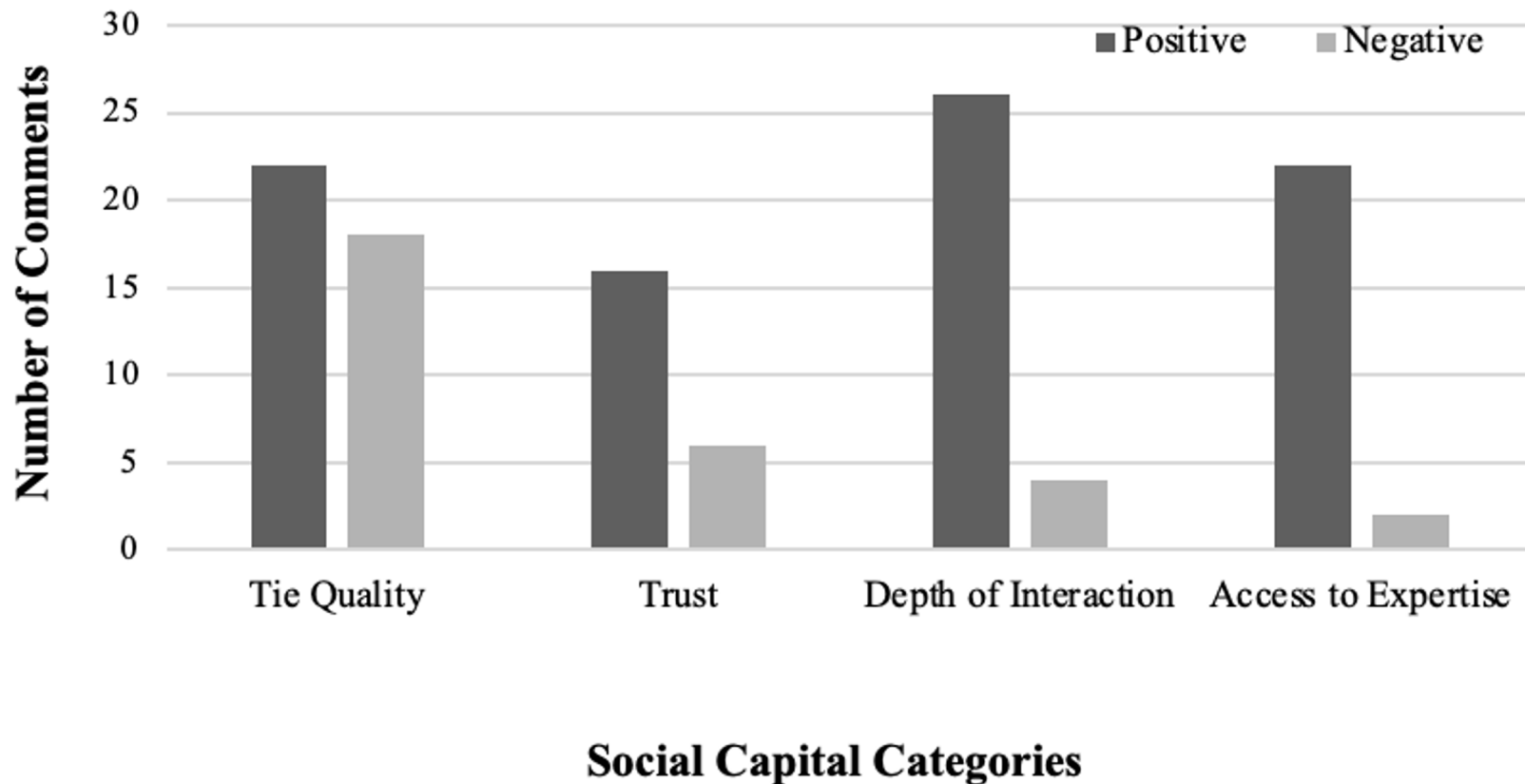
Teacher Participation Outcomes: PD Satisfaction



Comparing teacher satisfaction outcomes from the face-to-face PD in the original BioGraph 1.0 project to outcomes from the first two iterations of the online BioGraph 2.0

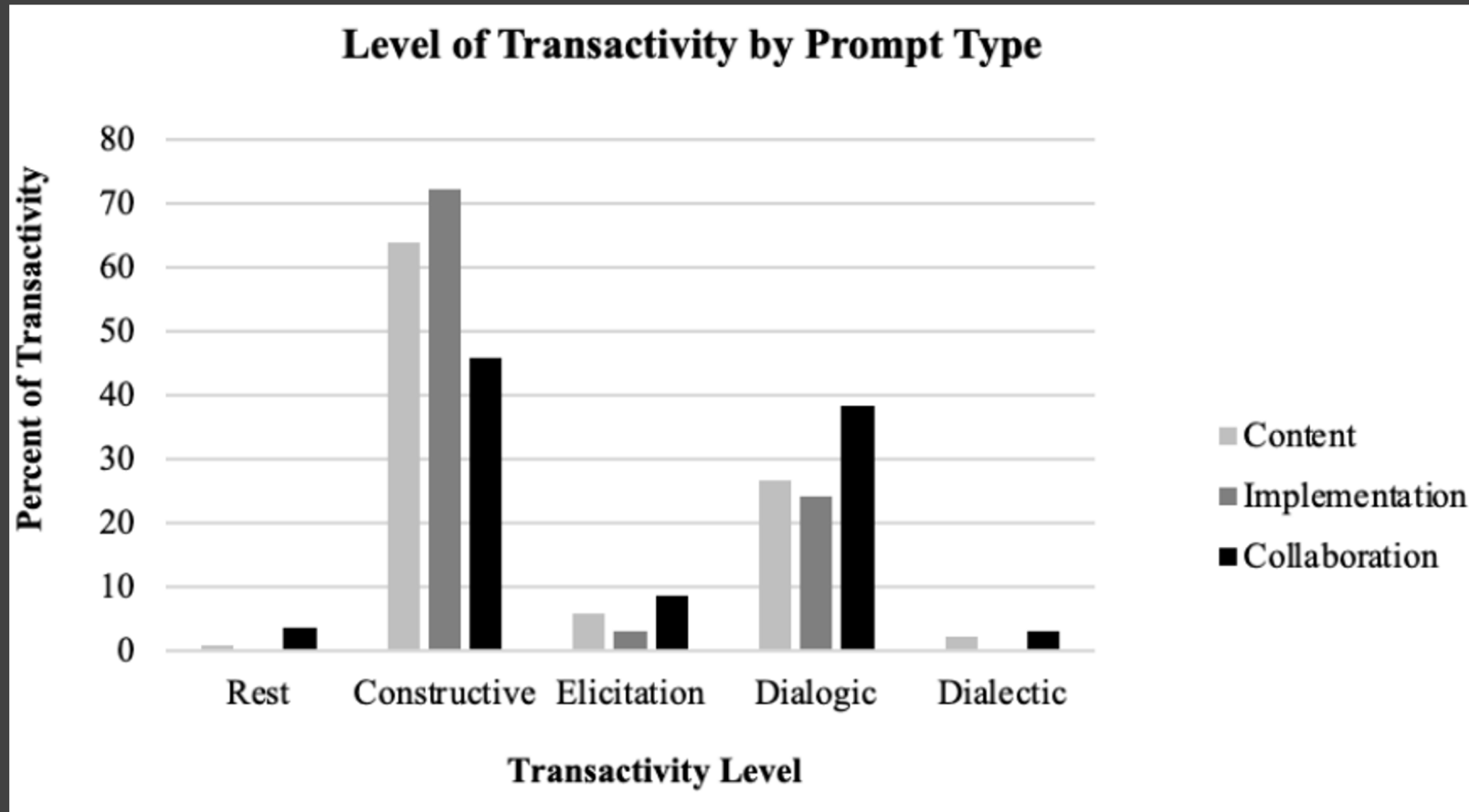
Teacher Participation Outcomes: Social Capital

**Teachers' Interview Responses on Online PD
Experiences Coded for Social Capital Categories**



Measuring teacher social capital based on post PD interviews from the first cohort of pilot participants in summer 2017

Teacher Participation Outcomes: Transactivity



Measuring teacher interaction by examining levels of transactivity in the PD discussion forums for the second cohort, summer 2018.

Content: Asking teachers to reflect on content knowledge

Implementation: Reflection on implementation in classroom

Collaboration: Actively prompting participants to collaborate with peers

Student Learning and Participation Outcomes

Comparison of student outcomes between the face-to-face PD in BioGraph 1.0 and the first two cohorts of the online BioGraph 2.0. Iteration 1.2 is an outlier because it was the second year the same group of teachers was working with BioGraph. All other iterations represent teachers in their first year teaching the content.

Iteration	<i>t</i> value	<i>df</i>	<i>p</i> value	Cohen's <i>d</i>
1.1	10.73	362	< 0.001	0.56
1.2	12.50	345	< 0.001	0.67
2.1	3.69	87	< 0.001	0.36
2.2	8.34	201	<0.001	0.61

Biology
Content

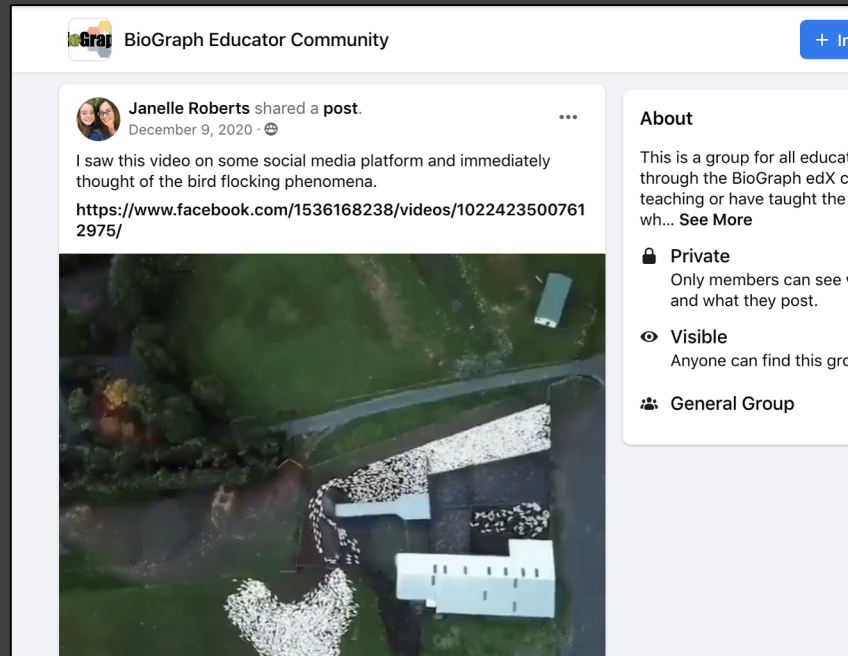
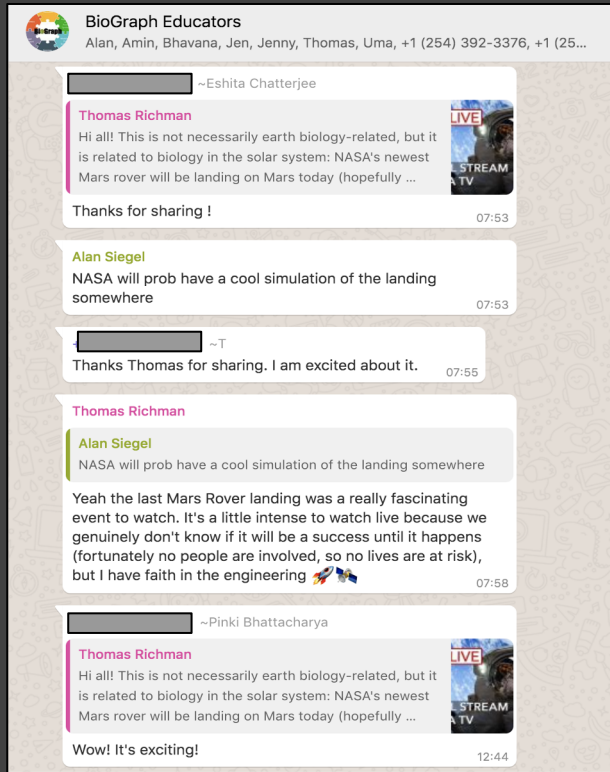
Iteration	<i>t</i> value	<i>df</i>	<i>p</i> value	Cohen's <i>d</i>
1.1	3.51	353	< 0.001	0.19
1.2	12.26	360	< 0.001	0.65
2.1	2.62	63	< 0.05	0.38
2.2	2.55	191	< 0.01	0.22

Complex Systems
Content

Iteration	<i>t</i> value	<i>df</i>	<i>p</i> value	Cohen's <i>d</i>
1.1	6.86	320	< 0.001	0.36
1.2	11.54	309	< 0.001	0.67
2.1	3.35	80	< 0.01	0.41
2.2	8.21	206	<0.001	0.49

Classroom
Experiences

Connecting a Global Community: Un-MOOCing



As the BioGraph community has grown to include over 120 teachers from across the United States and 17 other countries, additional social media and resource sharing platforms are used to keep the community connected.

Facebook Group

BioGraph Curriculum Materials and Resources

[Home](#) / [Courses](#) / [BioGraph Curriculum Materials and Resources](#)

Overview

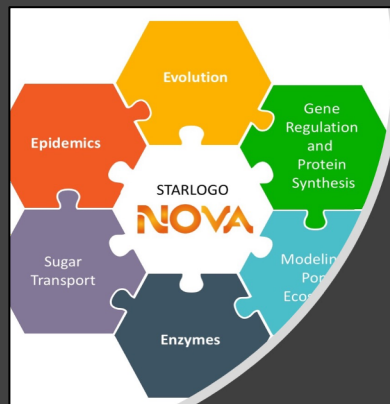
This section of the BioGraph Moodle contains the BioGraph curriculum units and associated resources. This is a unit where you can add your own resources, tips and tricks, or questions.

Note: [click here](#) for instructions for adjusting your forum notification (email) settings.

Moodle Community Resource

WhatsApp Group

Synchronous Meetups



Welcome BioGraph Participants!

To a Synchronous Meet-up for

The BioGraph Community

The meeting will begin shortly.

BioGraph 2.0 Publications

Yoon, S.A. (in press). Designing complex systems curricula for high school biology: A decade of work with the BioGraph project. To appear in Knipples, M.C. and Ben Zvi Assaraf, O. (Eds.) *Understanding Complexity in Biology Education*. Routledge Press.

Marei, A., Yoon, S. A., Yoo, J., Richman, T., Noushad, N., Miller, K. and Shim, J. (2021). Designing Feedback Systems: Examining a Feedback Approach to Facilitation in an Online Asynchronous Professional Development Course for High School Science Teachers. *Systems*, 9(1), 1–23.

Yoon, S. A., Miller, K., & Richman, T. (2020). Comparative Study of High-Quality Professional Development for High School Biology in a Face-to-Face versus Online Delivery Mode. *Educational Technology & Society*, 23(3), 68–80.

Yoon, S. A., Miller, K., Richman, T., Wendel, D., Schoenfeld, I., Anderson, E., Shim, J., & Marei, A. (2020) A social capital design for delivering online asynchronous professional development in a MOOC course for science teachers. *Information and Learning Sciences*, 121(7), 677–693.

Yoon, S. A., Miller, K., Richman, T., Wendel, D., Schoenfeld, I., Anderson, E. & Shim, J. (2020). Encouraging collaboration and building community in online asynchronous professional development: designing for social capital. *International Journal of Computer-Supported Collaborative Learning*, 15(3), 351–371.

BioGraph 2.0 Conference Proceedings Papers

Richman, T., Yoon, S. A., Marei, A., Miller, K. (2021, June 7–11). Analyzing Peer Interaction as Asynchronous Online Professional Development Scales Up to Include More Teachers [Poster session]. International Society of the Learning Sciences 2021 Conference.

Yoon, S., Miller, K., Richman, T., Wendel, D., Schoenfeld, I., & Anderson, E. (2020). Comparative study of high-quality professional development for high school biology in a face-to-face vs. online delivery mode. Paper in the proceedings of the International Conference for the Learning Sciences, Nashville, TN. <https://icls2020.exordo.com/programme/presentation/186> (Conference canceled)

Reisman, A., Yoon, S., Anderson, E., Brown, T, Correnti, R., Ebby, C., &...Fishman, B. (2020). Designing online experiences to support teacher learning and professional development across subject areas. Symposium in the proceedings of the International Conference for the Learning Sciences, Nashville, TN. <https://icls2020.exordo.com/programme/presentation/3> (Conference canceled)

Yoon, S., Miller, K., Shim, J., Wendel, D., Schoenfeld, I., Anderson, E., et al. (2019). From face-to-face to online: Considerations for social capital design to scale science teacher access to high-quality PD. In the proceedings of the International Conference of Computer Supported Collaborative Learning, Lyon, France.

Miller, K., Yoon, S., Shim, J., Wendel, D., Schoenfeld, I., Anderson, E., et al. (2019). Teacher perceptions on collaborative online professional development for in-service teachers on a MOOC platform. In the proceedings of the International Conference of Computer Supported Collaborative Learning, Lyon, France.

BioGraph 2.0 Conference Presentations

Yoon, S., Miller, K., Richman, T., Shim, J., Wendel, D., Schoenfeld, I., Anderson, E. (2021, April). Designing online PD for science teachers through building social capital. Symposium to be presented online at the annual meeting of the American Educational Research Association.

Marei, A., Yoon, S.A., Yoo, J., Richman, & Miller, K. (2021, April). Online Facilitation Strategies: An Opportunity for Supporting Learner Engagement. Poster presentation to be presented online at the annual meeting of the American Educational Research Association.

Richman, T., Yoon, S.A., Marei, A., Miller, K. (2021, April). Scaling interaction: Examining differences in teacher discourse as asynchronous online professional development scales up [Paper session]. American Educational Research Association 2021 Conference.

Yoon, S. (2020, April). A new generation of goals for scientific modeling: Strategies and lessons learned for reach and impact. Symposium to be presented at the annual meeting of the American Educational Research Association. San Francisco, CA. https://convention2.allacademic.com/one/aera/aera20/index.php?cmd=Online+Program+View+Session&selected_session_id=1575747&PHPSESSID=ff7890ctk8u8rgphuu0irlvsij (Conference canceled)

Miller, K. M., Yoon, S. A., Wendel, D., Schoenfeld, I., Reider, D. & Anderson, E. (2020, Apr). Designing high-quality online professional development in systems-based high school biology for greater geographic reach [Symposium]. AERA Annual Meeting. San Francisco, CA <http://tinyurl.com/vmdz82o> (Conference Canceled)

Miller, K., Yoon, S., Richman, T., Wendel, D. & Anderson, E. (2020, March). Building community in an online asynchronous PD course: Designing for social capital development. Paper presented at the meeting of the National Association for Research on Science Teaching, Portland, OR. <https://narst.org/sites/default/files/2020-04/NARST%202020%20Conference%20Program%20Book%20with%20URLs.pdf> (p.161) (Conference canceled)

Miller, K., Yoon, S., Shim, J., Wendel, D., Schoenfeld, I. & Anderson, E. (2019, April). Design considerations for building a more collaborative MOOC for in-service teacher professional development. Poster session to be presented at the annual meeting of the American Educational Research Association, Toronto, ON.

Yoon, S. Miller, K., Shim, J., Wendel, D., Schoenfeld, I., Anderson, E., & Reider, D. (2019, August). A social capital MOOC design for the delivery of high-quality PD to science teachers. Paper presentation submitted to the Biennial meeting of the European Association for Research on Learning and Instruction, Aachen Germany.

Implications and Impact from BioGraph 2.0

Addition to the literature on teachers' needs for online PD

- Structured facilitation and access to expert peers
- Second chance strategies, the multiple session design
- Synchronous meet ups to support asynchronous learning
- Just-in-time support
- Representation within the curriculum to make the resources more contextually relevant to a global community

Addition to the literature on building social capital in online PD

- Explicitly prompting for collaboration and transactivity
- Synchronous component which allows for

Support for past research that shows online PD, including primarily asynchronous PD, can be as affective as face-to-face PD

BioGraph 2.0 Team Members

University of Pennsylvania Team

Dr. Susan Yoon (PI)

Katherine Miller (Project Manager)

Thomas Richman

Amin Marei

Joeeun Shim

Miyoung Park (former team member)

Jae-un Yoo (former team member)

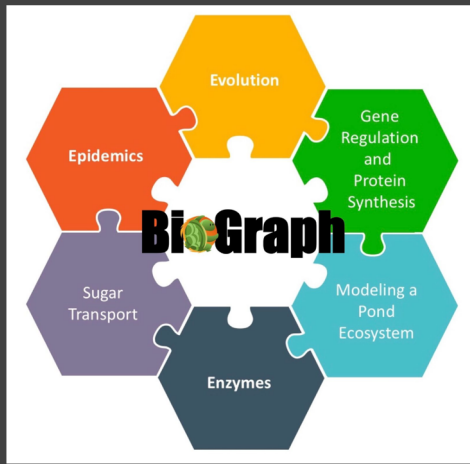
Massachusetts Institute of Technology Team

Dr. Eric Klopfer (Co-PI)

Daniel Wendel

Dr. Emma Anderson

Ilana Schoenfeld (former team member)



THANK YOU

Funded by the US National Science Foundation Discovery
Research K12 (DRL#1721003)
email: yoonsa@upenn.edu

