The PBL Projects Webinars: A Pandemic Creates New Opportunities

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Abstract: When the 2020 Covid-19 pandemic prevented an in-person problem-based learning (PBL) workshop in 2020, the authors developed and presented a series of virtual photonics workshops hosted by the Optical Society (OSA).

1. Background: The PBL Projects

1.1. What are the PBL Projects?

The PBL Projects are a series of STEM problem-based learning curriculum and professional development projects funded by the Advanced Technological Education (ATE) program of the National Science Foundation (NSF) [1]. Each of the PBL Projects has developed a collection of authentic real world multimedia case studies called "Challenges" with industry and research university partners in the areas of optics and photonics, sustainable technologies, and advanced manufacturing.

Students engaged in the PBL Projects are charged with solving an open-ended real world industry-based problem. Students work in teams, have an opportunity to develop and test a prototype (if appropriate in their course of study), present their solutions to their peers, and learn how the industry partner solved the same authentic problem. This process allows students to connect STEM concepts to the real world, get a feel for industry and new career fields, and compare and contrast their solution with that of an actual company.

Additionally, the PBL Projects provide professional development activities for secondary and post-secondary STEM educators and teacher educators. The projects train instructors by hosting "learn by doing" workshops in which instructors experience the PBL process as a student. Participating instructors gain access to an archive of teachers' resources and are introduced to implementation and assessment strategies for PBL. The PBL Challenges have been aligned to U.S. national science, math and technological literacy standards and the Common Core, and are available on the Internet at no cost.

1.2. The Problem-Based Learning in Advanced Photonics Manufacturing (APM-PBL) Project

Funded by a grant from the Advanced Technological Education program of the National Science Foundation (NSF-ATE; DUE #1801115) to Springfield Technical Community College in 2018, this three-year curriculum and faculty professional development project builds upon the successful NSF-ATE PHOTON PBL, STEM PBL and AM-PBL projects of the New England Board of Higher Education to increase the STEM pipeline of high school and community college students prepared and motivated to pursue careers in photonics technology through the use of PBL focused on advanced photonics manufacturing. Working in partnership with advanced photonics manufacturing industry partners across New England, the project is developing a comprehensive series of interdisciplinary multimedia PBL Challenges, focused on real-world problems in advanced photonics manufacturing faced by industry. The project is also providing professional development to STEM educators in their use in the classroom [2].

Due to the COVID-19 pandemic, however, the first 4-day professional development summer workshop scheduled to take place on the campus of Springfield Technical Community College in July 2020 was postponed to July 2021. Initially, we had anticipated that the pandemic would have ended by spring 2021 and we would be able to

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host an in-person workshop in summer 2021. Unfortunately, the pandemic still persists and the format of the summer 2021 workshop has been changed to a virtual format to be delivered via Zoom®. One silver lining of having to transition the PBL workshop to an online format is that we are now able to include participants from countries outside of the United States.

2. The APM-PBL Webinars

3.1. Webinar Topics

One of the challenges of postponing a summer workshop for one year is keeping the original participants engaged and connected with the project. After evaluating participant applications to the project, we learned that most of the participants had little or no formal background in optics and photonics. Given that we had a one-year postponement, the authors decided to develop and offer a series of five webinars focused on introductory optics and photonics concepts as well as PBL methodology in preparation for the summer 2021 virtual PBL workshop. The Optical Society (OSA) offered to host these webinars as part of the "We Are On" series.

Each one-hour live webinar (45 minutes of content material, 15 minutes for questions) was conducted mainly at the algebra/trig level suitable for teachers of students in high school and community colleges. Students were also encouraged to participate. Webinar content was based on the textbook by professors Donnelly and Massa, *LIGHT: An Introduction to Optics and Photonics, ed. 2* [3]. Each webinar was developed into a page of additional teaching resources such as applications and hands-on activities. These resources along with recordings of the webinars can be found on the PBL Projects website https://www.pblprojects.org/resources-from-pbl-osa-webinars/. The webinar topics are shown in Table 1.

Table 1. The APM-PBL Webinars

Date	Title	Topics
October 8, 2020	Geometric Optics	Reflection & Refraction, Lenses & Mirrors
November 19, 2020	Wave Optics	Diffraction & Interference, Polarization
February 11, 2021	Intro to Lasers	Basic Laser Operation, Laser Types & Applications
March 11, 2021	Intro to Fiber Optics	Fiber Optic Cable Structure, TIR, dB Loss, Dispersion
May 6, 2021	Intro to PBL	PBL Principles, PBL Challenges, Classroom Implementation

3.2. Webinar Attendees

The PBL Project Webinars attracted a total of 206 educators and students from 20 countries. A breakdown of participants is shown in Table 2. Several attendees, including international educators, have been added to the participants of the July virtual PBL workshop.

Table 2. APM-PBL Webinar Attendees

Webinar Topic	Total Attendees	Attendee Countries
Geometric Optics	53	USA, Mexico, Egypt, Romania, Uganda, France, Turkey, Canada, Italy
Wave Optics	26	USA, Ireland, UK, Poland, India, Iran
Intro to Lasers	34	USA, Poland, Germany, Philippines, Iraq, UK, Italy, Kenya
Intro to Fiber Optics	72	USA, Poland, Puerto Rico, Mexico, Greece, France, Iran, Finland, Poland, Germany, Romania, Canada, Ireland
Intro to PBL	21	USA, Finland, Romania, Germany, India, Uruguay, Turkey

4. Conclusion

The COVID-19 restrictions on hosting an in-person professional development workshop in PBL with a focus on advanced photonics manufacturing has opened up new opportunities to expand the scope and reach of the APM-PBL project to participants from 20 countries. The authors were able to use the one-year delay in their summer 2020 professional development workshop to develop and offer five new webinars focused on optics & photonics principles and PBL instructional methods to an international audience in partnership with OSA.

5. References

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