The Understanding Professional Development and Adoption Variation Related to Revised Advanced Placement Curriculum (PD-RAP) project was designed to examine how teachers responded to mandated changes in the AP curriculum in terms of their participation in professional development (PD). The AP exams are administered by the College Board, a U.S. nonprofit corporation designed to promote access to higher education. They provide curriculum guidelines and national exams for high school students in a variety of subject areas. Depending on the discipline and the student score on the exam, students can obtain college credit or advanced placement in college courses. The theoretical framework underlying the project was that teachers would engage in particular PD patterns based on their level of concern about the new curriculum as well as their and their school characteristics. Teachers across the U.S. completed a questionnaire during the first year of the redesign; biology exams and curricula were changed in 2013, chemistry in 2014 and physics in 2015. The questionnaire asked about support the teachers received from their schools, teachers’ perception and implementation of the curriculum, their PD participation, demographic information and information about their school context. The sample of teachers in the first three years of the AP redesign across disciplines with usable data included over 10,000 teachers. The results indicate that the teachers across years and disciplines made very individualized PD choices. Across disciplines the largest proportion of a teacher's PD activities was concentrated in material formats, followed by face-to-face PD, and online communities; online courses were the least frequently chosen PD activities. These choices do not appear to be related the teachers’ attitudes toward PD or any levels of concern related to the curriculum implementation.

RELEVANCE AND SIGNIFICANCE TO SCIENCE EDUCATION RESEARCH

The U.S. has been in a process of change in its approach to STEM education. The National Research Council (NRC) report, A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas (2012) stresses scientific inquiry and reasoning, reduces the emphasis on broad content coverage, and focuses on depth of understanding, which aligns with the Next Generation Science Standards (NGSS Lead States, 2013). To align with these recommendations instruction in high school science classes has to change. One compelling force for curricular change is assessment and a major player in high school assessment is the College Board.

The Advancement Placement (AP) program is offered by the College Board as a means of introducing rigorous, college-level material to high school students across a broad range of subject areas. The College Board defines curriculum standards for AP courses, and offers corresponding examinations that are administered in centralized locations under controlled conditions and graded centrally for quality control and norming. The examinations are scored on a 1-5 scale. Students who earn a 3 or higher can, depending on the institution of higher education, use their scores towards college-level credit. There are no “official” College Board curriculum materials, so teachers develop their own curriculum plan that must be certified by the College Board to list the course as
“Advanced Placement.” Over the past four years the College Board has instituted sweeping changes in its exams, phasing them in each year for biology, then chemistry, then physics.

This study is significant because it investigates the behaviors of teachers confronted with this national change in curriculum and testing. The study utilizes a framework for professional development informed by three models. It employs the Concerns-Based Adoption Model (CBAM) (Hall & Hord, 1984) as an initial framework for understanding how AP teachers perceive the AP Redesign and related professional development (PD) with respect to their own needs. The CBAM is an approach for understanding and managing change. It posits that people go through seven stages of concern and professional development should be most effective if there is congruence between the teacher’s stage of concern and the PD the teacher receives. Thinking about PD from the perspective of the teachers engaging in it is important, as the value and utility teachers assign to PD are associated with their learning from it (Penuel, Fishman, Yamaguchi, & Gallagher, 2007). Desimone’s (2009) theory of action for teacher PD asserts that teachers participate in learning experiences from which they derive knowledge and skills. They then incorporate these into practice, which eventually leads to gains in student achievement. A third model by Borko, Jacobs, and Koellner (2010) considers the content, process, and structure of high quality PD, and concludes that the best PD offerings are both situated in teachers’ practice and focused on students’ learning. Borko et al. (2010) find that effective PD is ongoing and sustainable, is integrated with other aspects of change within the school, and focuses on modeling preferred instructional strategies building professional learning communities. Opfer and Pedder (2011) take the ideas of PD integrated with other aspects of change within the school further in a conceptual discussion that considers the dynamic interactions of individual teachers, school contexts, and PD activity designs and provides a contextualized model for teacher PD. Findings from this study offer practical insights into teacher behavior that could be important for the development and implementation of similar programs in other areas of science.

**METHODS**

The survey was designed to match the guiding frameworks and contained questions related to, PD participation, teaching background, attitudes towards PD, levels of concerns, AP course and instruction, school context, and teacher demographics. The survey was designed using best practices including talk-aloud techniques and took between 30-45 min to complete. The survey was delivered to all teachers in May of each year. Across the disciplines and data collection years, approximately 10,000 teachers responded with response rates of 23% to 34%, which is considered good for web-based surveys with populations of this size (Shih & Fan, 2009). The non-response analyses showed that the responding population of teachers was skewed toward those who teach at schools with higher performing and higher SES students. The analyses were a combination of cross tabulations and predictive modeling techniques depending on the nature of data.

**RESULTS**

The results presented here concentrate on the description of the teacher use of PD and the relationships of perception of PD and level of concern to the use of face-to-face PD. Teachers were presented with a predefined list of PD types and indicated whether they did or did not participate in each PD in the prior year. The list was based on (a) the PD activities that College Board offered during each year and for each discipline; (b) a literature search identifying common activities teachers participate in for their PD; and (c) expert knowledge of PD offerings. Teachers’ PD participation in PD activities will be described across years and disciplines by PD format (face-to-face, online courses, online communities, and materials).

Teachers were asked to rate the top reasons why they chose to participate in a particular PD. The results showed that across years and disciplines; emphasized content, convenience, reputation of the program, and cost were the most important criteria that teachers used to make their choice of PDs. The results showed that across years and discipline, the largest proportion of a teacher's PD activities was concentrated in material formats, followed by face-to-face PD, and then online community participation; online courses took the smallest proportion of a teacher's PD activities.

The relationship for face-to-face PD with teacher level of concern was also examined. For biology teachers although the conditional model with teacher concerns fit better, the teacher concerns variable was not
significant. For chemistry teachers the model with teacher concerns did not improve the fit. For physics teachers higher levels of concern were related to utilizing fewer face-to-face PD.

The relationship of teacher participation in face-to-face PD and other variables was examined. Biology teachers who had the belief that PD enhances instruction and student performance or who reported more workload were more likely to use more face-to-face PDs when controlling for all other variables in the model. Biology teachers who were from a school with a higher percentage of students eligible for free- and reduced priced lunch programs were also more likely to use more face-to-face PDs. Chemistry teachers who had belief that PD enhances instruction and student performance or who reported more workload or who reported higher support from school administrators were more likely to use more face-to-face PDs when controlling for all other variables in the model. Chemistry teachers who were from a school with higher percent of students taking AP exam were more likely to use more face-to-face PDs. The results for physics teachers showed that their PD inclination, administrative support, workload, perceived challenges with the redesign, and self-efficacy related to using higher levels of face-to-face PD.

DISCUSSION

The information here helps to show what type of professional development teachers faced with a national curriculum redesign chose to participate in and what variables were related to that PD choice. This information will help educational stakeholders to provide future curriculum change programs to design professional development that would coincide with teacher preferences.

ACKNOWLEDGEMENTS

This work is supported by the National Science Foundation through the DRK-12 program, award number 1221861. The authors also thank the following people for their contributions to this work: Ted Gardella and Amy Wheelock of the College Board, Allison Scheff of the Massachusetts Board of Higher Education, and the thousands of AP teachers who helped shape and participated in this project. The views contained in this paper are those of the authors, and not their institutions, the College Board, or the National Science Foundation.

REFERENCES


