Non-Users, Lurkers, and Posters in the Online AP Teacher Community: Comparing Characteristics Determining Online Engagement

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This empirical study explored participation patterns of 1,733 Advanced Placement (AP) Physics teachers in the online AP teacher community (APTC) following the redesigned AP science examinations in the United States. We identified profiles of teachers with different levels of engagement in this peer-based online learning community. Our results provide insight into underrepresented user groups and the development of more personalized online teacher support systems. Our analysis suggested that teachers' knowledge and experience, the enactment of AP practices, challenges with the AP redesign, and AP workload were all significantly associated with changes in the probability of teachers becoming APTC users. This indicated that the APTC attracted a non-representative population sample of all AP physics teachers. However, most teacher, teaching, and school characteristics provided no indication as to whether APTC users were posters or lurkers.

1 Introduction

This study analyzed teacher engagement patterns in a peer-based online learning community. It is part of a longitudinal National Science Foundation funded research project on teacher learning related to the redesign of the Advanced Placement (AP) examinations in the United States. AP courses provide rigorous, college-level learning opportunities for high school students on a broad range of subjects. The summative AP examinations (graded on a 1-5 scale) are high-stakes because students might be able to substitute introductory college courses with passing grades above a threshold value in AP courses (usually 3 or higher), depending on corresponding college policies. In addition, AP courses increase students' competitiveness in the U.S. college application process.

In response to recommendations from the National Research Council (2002), the College Board (the provider of the AP examinations) increased the emphasis on scientific inquiry, reasoning, and depth of conceptual understanding while de-emphasizing rote memorization and algorithmic schemata. This nation-wide redesign in the sciences was introduced in 2013 (Biology), 2014 (Chemistry), and 2015 (Physics). Preparing teachers for these large-scale changes, the College Board and other providers offered a broad range of professional development (PD) opportunities, including face-to-face workshops, self-paced online courses, downloadable materials, and peer-based online learning communities. Prior analysis indicated that, while some characteristics of teachers and schools were linked with student scores, significant direct associations for most PDs on student performance were difficult to confirm (Fischer et al., 2015; Fishman et al., 2014). However, out of the PD options studied, participation in the online AP teacher community (APTC)

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had the most consistent, direct, and positive association with both teaching practices and students' AP scores (Fishman et al., 2014). To better understand this, we chose to further study teachers' ATPC participation and engagement patterns. Our findings might also benefit teachers faced with other large-scale curriculum changes, such as the Common Core State Standards Initiative or the Next Generation Science Standards.

2 Theoretical Framework

2.1 Peer-Based Online Learning Communities

Successful peer-based online learning communities can be seen as *"communities of practice"* (Lave & Wenger, 1991) in a virtual environment *"where people come together with others to converse, exchange information or other resources, learn, play, or just be with each other"* (Kraut & Resnick, 2012, p. 1). Barab, MaKinster, and Scheckler (2003) define such virtual communities of practice as *"persistent, sustained social network[s] of individuals who share and develop an overlapping knowledge base, set of beliefs, values, history and experiences focused on a common practice and/or mutual enterprise"* (p. 238).

To distinguish participation patterns in online communities, users are often categorized as either posters or lurkers. *Posters* describe users who generate visible content, whereas *lurkers* are depicted as silent, observation-oriented, and 'invisible' users. Although lurkers' engagement is commonly viewed as passive, lurkers are valuable participants in, for instance, providing an audience for posters, or engaging in goal-driven, active information seeking behavior (Edelmann, 2013). Thus, based on the context, lurking might be characterized as *"legitimated peripheral participation"* (Lave & Wenger, 1991) in virtual communities of practice.

2.2 Professional Development Participation

In the complex system of schooling, the importance of teachers in improving student learning outcomes is widely acknowledged (Hattie, 2009). Teacher education and PD programs are seen as crucial for raising student achievement in educational reform efforts (Darling-Hammond, Wei, Andree, Richardson, & Orphanos, 2009; Loucks-Horsley & Matsumoto, 1999). Models of teacher learning emphasize the mediating character of PD programs. High-quality PD seeks to increase teachers' knowledge and skills, which in turn lead to changes in instructional practices, ultimately fostering student learning and achievement (Desimone, 2009; Fishman, Marx, Best, & Tal, 2003). Systematic empirical research efforts on PD effectiveness identified several design characteristics constituting 'high-quality' PD (e.g., Banilower, Heck, & Weiss, 2007; Garet, Porter, Desimone, Birman, & Yoon, 2001; Penuel, Fishman, Yamaguchi, & Gallagher, 2007), which Desimone (2009) summarizes as (a) content focus, (b) active learning, (c) coherence, (d) duration, and (e) collective participation.

While the majority of empirical studies analyzed these PD characteristics for traditional face-to-face PD activities, Dede, Ketelhut, Whitehouse, Breit, and McCloskey (2008) described the current state of research on online teacher PD activities. Fishman et al. (2013) provided an overview of the relatively few studies comparing face-to-face and online PD programs. However, the research base on online teacher communities is still developing.

2.3 Research Questions

This study represents an effort to extend the research base on online teacher community research by exploring characteristics that predict different types of PD engagement (non-user, lurker, and poster) in the APTC. This study explored AP Physics teachers' participation and engagement profiles in the APTC through the following research questions:

1. What patterns of teacher and school characteristics exist among non-users and users of the APTC?
2. What patterns of teacher, school, and APTC engagement characteristics exist among lurkers and posters?

This study defined *non-users* as teachers who did not participate in the ATPC at all. *Users* were categorized as self-reported APTC participants (either lurker or poster). Given that the field did not establish universal definitions of lurkers and posters, we categorized teachers as lurkers and posters using three slightly different approaches based on teachers' self-reported activities within the APTC. Thus, we accounted for the sensitivity of this conceptualization by applying statistical models that only differed in the lurker-poster categorization. The following lurker-poster categorizations were applied:

1. *Lurkers* were APTC users who self-reported as never having posted in APTC online forums and never having uploaded any teaching resources. *Posters* were teachers who self-reported as having posted at least once in an online forum or uploaded at least one teaching resource.
2. *Lurkers* were APTC users who self-reported that they spent less than 2.5% of their time in the APTC posting in online forums and/or uploading teaching resources. *Posters* were teachers who self-reported that they spent at least 2.5% of their time in the APTC posting in online forums and/or uploading teaching resources.
3. *Lurkers* were APTC users who self-reported that they spent less than 5.0% of their time in the APTC posting in online forums and/or uploading teaching resources. *Posters* were teachers who self-reported that they spent at least 5.0% of their time in the APTC posting in online forums and/or uploading teaching resources.

3 Methodology

3.1 Data Sources

Web-based surveys were sent to all AP Physics teachers in May 2015 except for teachers who were placed on a 'do not contact' list; the surveys asked about demographic information, teaching background, concerns with the AP redesign, PD participation, attitudes towards PD, AP science course instruction, and school context. The response rate for the 2015 AP Physics survey was 33.65%. The sample for this study included data from AP Physics teachers (N=1,733) teaching in the United States. Non-parametric Mann-Whitney tests indicated that the schools of the teachers who responded to the survey were associated with slightly lower enrolment in free- or reduced-priced lunch programs (M = 28.31, SD = 24.49) compared to the schools of teachers who did not respond to the survey (M = 31.79, SD = 25.18), z = 4.190, p < 0.001, d < 0.139.

In order to reduce sampling biases, missing data was imputed through Markov Chain Monte Carlo multiple imputation methods with 150 iterations and 40 imputations, yielding power falloffs smaller than 1% compared to full information maximum likelihood approaches (Graham, 2009). Also, teachers responding to less than 1/3 of the survey questions were dropped from the analysis.

3.2 Measures

The dependent variable used in the first research question concerned whether teachers were *non-users* (N = 1,003) or *users* (N = 730) of the APTC. The dependent variable in the second research question indicated teachers' APTC engagement as lurkers or posters (def. 1: N_{lurk} = 409, N_{post} = 321; def. 2: N_{lurk} = 449, N_{post} = 281; def. 3: N_{lurk} = 480, N_{post} = 250).

Single indicator independent variables included demographic information such as teachers' *birth year*, *gender*, and *racial background*. Regarding APTC participation, teachers were asked to report their average *frequency* and *duration* of APTC visits. Inspired by Desimone's (2009) characteristics of 'high-quality' PD, five-point Likert scale variables were used to assess teachers' perceptions of how *responsive the APTC was towards their needs and interests*; if teachers' interactions with the APTC had a *focus on student work*; if *teaching was modeled* in teachers' interactions with the APTC; if teachers used opportunities to *build relationships with colleagues*; and if teachers felt *effectively supported with teaching the redesigned AP course*. Furthermore, teachers indicated whether *accessing re-*

sources, *asking questions*, *obtaining recommendations regarding the AP redesign*, *sharing ideas and insights*, and *social interactions* were reasons for their APTC participation. Teachers' racial background as well as frequency and duration of APTC participation were included as a series of dummy variables (but were still counted as single indicator variables).

Composite independent variables were computed based on exploratory and confirmatory factor analysis, as well as conceptual considerations. The number of retained factors was determined through the Guttman-Kaiser criterion and scree plot analysis. Parameters were derived with normalized oblimin oblique rotation methods computing standardized Bartlett factor scores. The following composite variables were included:

- *Teachers' PD inclination* (importance of PD to instructional performance, importance of PD to student performance, effectiveness of self-teaching, efficacy of PD participation, enjoyment of face-to-face PD);
- *Teachers' self-efficacy* (student performance is based my effort, students get better scores due to effective teaching, teaching overcomes inadequate students science backgrounds, extra teaching effort does not change AP scores);
- *Teachers' knowledge and experience* (years teaching high school science, years teaching AP science, professional science teaching organizations, conference attendances, years serving as AP Reader, years serving as AP Consultant, time of assignment for AP science);
- *Enactment of AP redesign practices* (students conduct lab investigations, conduct inquiry lab investigations, report lab findings to each other, use lab science practices in class, guidance on content questions, guidance on open/free response questions);
- *Enactment of the AP redesign curriculum* (refer to the *"Big Ideas,"* refer to how enduring understandings relate to the *"Big Ideas,"* refer to learning objectives from AP curriculum, refer to the curriculum framework);
- *Challenges with the AP redesign* (content, organization of content, labs, inquiry labs, format of questions/problems/exam, application of science practices, new syllabi, *"boundary statements,"* design new student assessments, use the textbook, work with new/different textbooks, pacing of course, move students to conceptual understandings);
- *AP workload* (number of students across all AP science sections, number of AP science sections, number of preps); and
- *Administrative support* (principal understands challenges for AP students, principal understands challenges for AP teachers, principal supports PD, lighter teaching load for AP teachers, fewer out-of-class responsibilities, additional funding for AP, availability of lab equipment, availability of consumable supplies).

3.3 Analytic Methods

Exploring both research questions, logistic regression analysis was conducted on teachers' APTC participation (research question one) and teachers' engagement as lurkers or posters (research question two). Teachers' APTC engagement is further explored with a sensitivity analysis that used the different lurker/poster definitions.

The assumptions of logistic regression were met. Teachers were uniquely distributed across binary teacher groups (non-user/user; lurker/poster). The sizes of the teacher groups were sufficiently large to conduct logistic regression analysis, fulfilling Peduzzi, Concato, Kemper, Holford, and Feinsteins' (1996) recommendation of more than 10 observations for every independent variable included in the analysis.

4 Findings

4.1 Participation Patterns among Non-Users and Users

The results of the logistic regression analysis indicated that certain teacher demographics, teaching, and school characteristics significantly predict whether teachers chose to participate in the APTC (table 1).

	β	Odd ratios	z
Intercept	-14.732		
Teacher demographics			
Birth year/100	0.724	2.063	1.30
Female	0.473***	1.606***	4.34***
Racial background (vs. White)			
Native American	-1.257*	0.284*	-2.55*
Asian or Asian American	-0.296	0.744	-1.19
Black or African American	-0.389	0.678	-1.03
Hispanic	-0.129	0.879	-0.48
Knowledge and experience[C]	0.213***	1.238***	4.19***
Teaching and school characteristics			
PD inclination[C]	0.020	1.020	0.38
Self-efficacy[C]	0.057	1.058	1.38
Enactment: AP practices[C]	0.222***	1.248***	4.83***
Enactment: AP curriculum[C]	0.069	1.072	1.40
Challenges with AP redesign[C]	0.227***	1.254***	4.50***
AP workload[C]	0.112*	1.119*	2.39*
Administrative support[C]	0.084	1.087	1.75

Tab. 1. Logistic regression analysis exploring the likelihood of teachers being non-users or users of the APTC (N = 1,733); [C]: Composite variable; *p<0.05, **p<0.01, ***p<0.001.

With everything else constant, the main significant findings were the following: Regarding teacher demographics, female teachers and teachers with greater knowledge and experience were significantly more likely to participate in the APTC. Female teachers' odds of APTC use were 60.6% greater than those of their male counterparts. Roughly every standard deviation increase in teachers' knowledge and experience was associated with a 23.8% increase in the odds of ATPC participation. Regarding teaching and school characteristics, teachers who used more AP redesign practices in their AP course enactment, who felt more challenged by the AP redesign, or who experienced a higher AP workload were significantly more likely to participate in the APTC. Roughly every standard deviation increase in teachers' enactment of AP redesign practices was associated with a 24.8% increase in the odds of APTC participation. Roughly every standard deviation increase in the challenges with the AP redesign reported was associated with a 25.4% increase in the odds of APTC use, and roughly every standard deviation increase in teachers' AP workload was associated with a 11.9% increase in the odds of ATPC use.

The influences of teacher, teaching, and school characteristics on teachers' likelihood of APTC participation can also be illustrated by calculating predicted probabilities. For instance, figure 1 suggests that the more teachers felt challenged with the AP redesign, the higher the predicted probability of participating in the APTC is, when all other variables are at their mean or mode values. Also, the gender gap in the predicted probabilities of APTC use is fairly stable across variations of teachers' perceived challenges with the AP redesign.

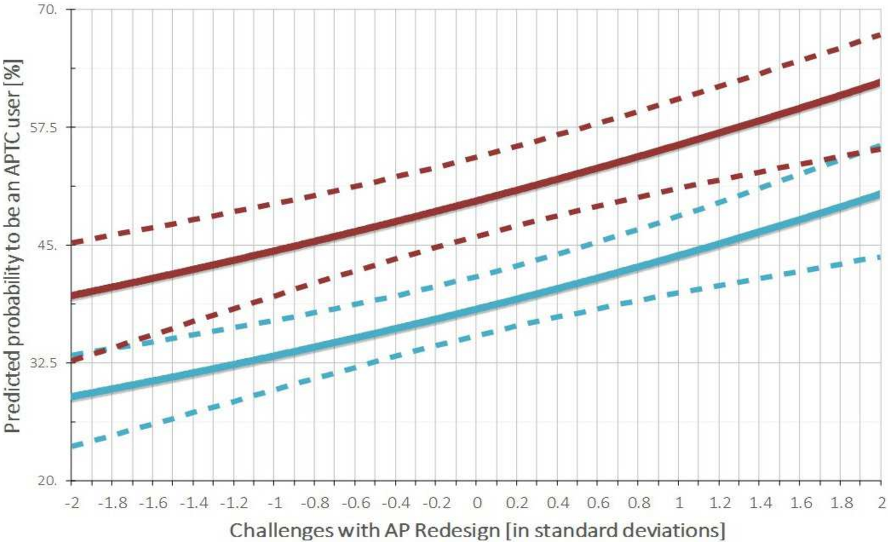

Fig. 1. Predicted probabilities of APTC participation for female (red) and male (blue) teachers with varying degrees of perceived challenges with the AP redesign; the dashed lines represent 95% confidence intervals.

4.2 Participation Patterns among Lurkers and Posters

The teacher, teaching, and school characteristics we measured and included in the logistic regression analysis did not significantly predict whether teachers were lurking or posting in the APTC, even accounting for differences in the definition of lurkers and posters through a sensitivity analysis (table 2). Significance levels for each variable were equal across all lurking and posting definitions with the exception of teachers' racial background (Black or African American vs. White) for the 2.5% threshold definition.

Nevertheless, analyzing teachers' engagement in the ATPC in more detail provided insight into whether teachers were lurkers or posters. Teachers' self-reported reasons for participating in the APTC substantially distinguished lurkers from posters. AP Physics teachers who participated in the APTC to ask questions about the redesign had greater odds of being posters than lurkers (>0% threshold: 531.9%; 2.5% threshold: 541.5%; 5.0% threshold: 492.4%). Similarly, AP Physics teachers who participated in the APTC to share their ideas and insights also had greater odds of being posters than lurkers (>0% threshold: 2,210.7%; 2.5% threshold: 2,067.4%; 5.0% threshold: 1,820.6%). Remarkably, none of the 'high-quality' PD characteristics inspired by Desimone (2009) showed significantly changes in the predicted probabilities of teachers being posters or lurkers. This indicated that the perceived PD experiences regarding the 'high-quality' PD characteristics for AP Physics APTC users' might be similar for both lurkers and posters.

5 Discussion and Recommendations

This study contributes to the research base exploring teachers' participation and engagement patterns in peer-based online learning communities. Ultimately, this project aims to understand what teacher supports are correlated with student outcomes during large-scale changes in tests and curricula. The shift in the AP science curricula constitutes a unique opportunity to examine teachers' PD participation patterns, including in the College Board's APTC. Additionally, this study represents a unique opportunity for online community research because it builds upon common approaches that solely analyze populations *within* online communities. We are able to compare ATPC users to *non-users*, due to our nation-wide sample of AP Physics teachers.

	[a]		[b]		[c]	
	β	Odd ratios	β	Odd ratios	β	Odd ratios
Intercept	-10.526		-7.060		-1.841	
Teacher demographics						
Birth year/100	0.449	1.566	0.284	1.329	0.035	1.036
Female	-0.367	0.693	-0.279	0.757	-0.320	0.726
Racial background (vs. White)						
Native American	0.050	1.052	0.423	1.526	0.679	1.973
Asian or Asian American	0.467	1.595	0.830	2.294	0.888	2.431
Black or African American	0.221	1.247	-1.934*	0.145*	-1.589	0.204
Hispanic	-0.076	0.927	0.375	1.454	-0.005	0.995
Knowledge and experience[C]	0.121	1.128	0.058	1.060	0.103	1.108
Teaching and school characteristics						
PD inclination[C]	-0.071	0.932	-0.156	0.855	-0.179	0.836
Self-efficacy[C]	0.053	1.055	0.097	1.101	0.109	1.115
Enactment: AP practices[C]	0.005	1.005	-0.029	0.972	-0.029	0.971
Enactment: AP curriculum[C]	-0.108	0.897	-0.029	0.972	0.009	1.009
Challenges with AP redesign[C]	0.080	1.083	0.086	1.090	-0.024	0.977
AP workload[C]	-0.014	0.986	-0.034	0.966	-0.017	0.983
Administrative support[C]	-0.031	0.970	-0.037	0.964	-0.083	0.920
APTC participation characteristics						
Frequency (vs. once per month or less)						
Every other week	0.167	1.182	0.030	1.031	0.074	1.077
Once or several times a week	0.319	1.375	0.293	1.341	0.304	1.355
Almost every day	0.106	1.112	-0.015	0.985	0.293	1.341
Duration (vs. less than 5 minutes)						
5 to 10 minutes	0.656	1.928	0.666	1.946	0.186	1.205
10 to 20 minutes	0.669	1.952	0.611	1.842	0.298	1.347
20 to 40 minutes	0.626	1.870	0.453	1.572	0.422	1.525
More than 40 minutes	0.219	1.245	-0.079	0.924	-0.473	0.623
PD characteristics						
Responsive agenda	-0.029	0.971	-0.018	0.983	-0.037	0.964
Focus on student work	0.129	1.137	0.175	1.191	0.188	1.207
Modeling teaching	-0.057	0.944	-0.100	0.905	-0.093	0.911
Building relationships	0.162	1.176	0.143	1.154	0.078	1.081
Effective support	-0.043	0.958	-0.077	0.926	-0.033	0.968
Reasons for participation						
Access resources	-0.112	0.894	-0.248	0.780	-0.322	0.725
Ask questions	1.844***	6.319***	1.859***	6.415***	1.779***	5.924***
Recommendations for AP redesign	-0.238	0.788	-0.511	0.600	-0.661	0.516
Share ideas/insights	3.140***	23.107***	3.076***	21.674***	2.955***	19.206***
Social interactions	-0.142	0.868	0.036	1.037	0.141	1.152

Tab. 2. Logistic regression analysis on the likelihood of teachers being lurkers or posters (N = 730); [C]: Composite variable; posters are teachers who posted and/or uploaded teaching resources at least [a] once, [b] 2.5% of their time spent in the APTC, [c] 5.0% of their time spent in the APTC; *p<0.05, **p<0.01, ***p<0.001.

The two main findings of this study are the following: First, the APTC is used by a particular teacher population in physics. APTC participation is more likely for female teachers, more knowledgeable teachers, teachers who enacted more AP redesign practices, teachers who experienced more challenges with the AP redesign, and teachers who reported a higher AP workload. This conclusion identified a selection bias in APTC participation patterns and, as such, APTC users are not representative of the overall AP Physics teacher population who responded to our survey. The uniqueness of the APTC teacher population might be attributable to characteristics of the APTC community. The APTC provides a rich environment in which teachers share teaching resources and engage in meaningful conversations on how to successfully approach teaching redesigned AP courses. This in turn might explain the positive correlations of teachers' APTC use on students' AP scores (Fishman et al., 2014). Secondly, none of the included teacher, teaching, and school characteristics significantly predicted whether AP Physics teachers were using the APTC as lurkers or posters. This indicated that lurkers and posters shared key characteristics and that APTC participants are not distinguishable based on individual teacher and school contexts *per se*. Teachers' self-reported reasons for participating were the most predictive factors for lurking or posting behavior, which indicated that the design of the APTC allowed teachers to choose how to participate in order to reach their individual goals.

Given the findings of this study, recommendations for researchers, PD providers and developers of online communities are as follows. First, before generalizing from a sample of users in an online community to the overall population (including non-users), statistical analysis should verify representativeness of the sample of online community users compared to non-users, instead of only comparing lurkers and posters. Secondly, if the intent is to diversify the population of an online teacher community, recruiting efforts should be intensified for underrepresented teacher populations (male teachers, teachers who enact fewer curricular reform elements, less knowledgeable and experienced teachers, teachers experiencing fewer challenges with curricular reforms, and teachers with lower teaching workloads).

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