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“Together we are better”: Professional learning networks for teachers

Torrey Trust ^{a,*}, Daniel G. Krutka ^b, Jeffrey Paul Carpenter ^c

^a University of Massachusetts Amherst, Teacher Education & Curriculum Studies, 813 North Pleasant Street, Amherst, MA 01003-9308, USA

^b Texas Woman's University, Teacher Education, P.O. Box 425769, Denton, TX 76204-5769, USA

^c Elon University, Campus Box 2105, Elon, NC 27244, USA

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ABSTRACT

In recent years, many educators have turned to professional learning networks (PLNs) to grow in their craft with peers who are more accessible online because of reduced temporal and spatial constraints. While educators have cultivated PLNs, there is a dearth of research about the effects of PLNs. This manuscript reports the findings of a qualitative study that investigated PLN experiences through the analysis of survey data from 732 P-12 teachers. Data analysis suggests that the anytime, anywhere availability of expansive PLNs, and their capacity to respond to educators' diverse interests and needs, appear to offer possibilities for supporting the professional growth of whole teachers. These findings have implications for defining the present and future of teacher learning in a digital age.

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The most important thing I learned [from my PLN] is that there is a community of enthusiastic amazing educators that are lifelong learners, always evolving their practice and learning from each other and from me. That was the kind of teacher I wanted to be but I didn't have the best role models of this around me. Once I found these communities online, especially on Twitter, I started being that force in person as well. I encourage my colleagues to share with me and I share with them. Together we are better.

- Female teacher from Canada in her 6th year

1. Introduction

The speed with which the Internet has arrived, evolved, and affected the lives of teachers and students of the 21st century is staggering. Scarcely a decade ago the quote above from the Canadian teacher would have been unlikely, but the arrival of Web 2.0 sites and social media platforms has facilitated anytime, anywhere learning occasions for teachers. With shortcomings in teacher professional development (PD) well documented (Opfer & Pedder, 2011), educators have increasingly

* Corresponding author.

E-mail addresses: torrey@umass.edu (T. Trust), dankrutka@gmail.com (D.G. Krutka), jcarpenter13@elon.edu (J.P. Carpenter).

used digital sites to cultivate and extend *Professional Learning Networks* (PLNs) to grow as educators. A PLN can be defined as a “system of interpersonal connections and resources that support informal learning” (Trust, 2012, p. 133).

While many educators claim to benefit from PLNs, much remains unknown about how teachers conceive of PLNs, what they learn from them, and how this affects their teaching and students’ learning. This manuscript reports the findings of a qualitative study in which we investigated teachers’ understandings of PLNs through the analysis of survey data from 732 teachers in Pre-Kindergarten to 12th grade settings. We begin by offering a theoretical lens that considers the complex processes of professional learning that supports *whole teachers*. We will review pertinent literature concerning PLNs and teacher learning. We then describe the data collection and analysis methods that yielded findings which suggest that PLN experiences support growth in affective, social, cognitive, and identity aspects of teaching. These findings have implications for (re)defining the present and future of teacher learning in the 21st century. We conclude by offering implications for research and practice, including suggestions that might help educators reflect upon participation in PLNs as a means to achieve professional growth.

2. Theoretical lens

While scholars have regularly called for the education of the whole child (e.g., Diamond, 2010; Miller, 2010; Noddings, 2010), particularly in early education, only recently have they suggested professional development that meets the needs of the *whole teacher* (Chen & Chang, 2006; Chen & McCray, 2012). Chen and colleagues proposed and implemented a theoretical framework for holistic teacher PD that sought to concurrently support teacher growth in attitudes, knowledge, and practices across various domains. Their integrated approach “is based on the premise that teacher attitudes, skills, and practices interact and influence each other. The dynamics of these interrelationships provide a basis for facilitating teacher development” (Chen & Chang, 2006; para. 5).

A whole teacher perspective reflects our view of teaching as a complex endeavor undertaken by professionals with cognitive, social, affective, and identity needs. In other words, like students, teachers “are whole persons—not mere collections of attributes, some to be addressed in one place and others to be addressed elsewhere” (Noddings, 2010, p. 5). If teachers are to continually develop their practice then they could benefit from broad, holistic, and flexible networks as they navigate shifting professional landscapes. The anytime, anywhere availability of expansive PLNs, and their capacity to respond to educators’ diverse interests and needs, appear to offer possibilities for supporting the professional growth of whole teachers.

3. Literature review

3.1. Teacher professional development

Quality PD experiences are believed by many scholars to be central to the improvement of teaching and student learning (e.g., Borko, 2004; Darling-Hammond, Wei, Andree, Richardson, & Orphanos, 2009; Garet, Porter, Desimone, Birman, & Yoon, 2001; Kennedy, 2016; Van den Bergh, Ros, & Beijaard, 2014), and they may even prevent teacher burnout (Wood, 2002). Many researchers agree that these types of experiences should be long-term, ongoing, social, constructivist, and situated in classroom practice (e.g., Desimone, 2009; Garet et al., 2001; Timperley & Alton-Lee, 2008; Van den Bergh et al., 2014). Yet, formal teacher PD often fails to meet such criteria.

Teacher PD has long been characterized by narrow aims that are disconnected from the broad, complex, and disparate needs of teachers (Opfer & Pedder, 2011). Traditional PD often includes short workshops or seminars that feature outside experts and that occur away from teachers’ home schools. Although such PD can introduce teachers to important knowledge and skills, it can also often lack depth and tends to focus mostly on content knowledge (Chen & McCray, 2012; OECD, 2014). More recently, Mary Kennedy (2016) has highlighted the “problem of enactment” that can result from PD programs that meet with educators outside of their classrooms but expect teachers to enact what they have learned inside of their classrooms (p. 3).

Traditional efforts at PD have also failed to respect the agency and needs of classroom teachers. Apple (2009) argued that top-down teacher PD in schools often aligns with hierarchical structures that de-skill teachers from their intellectual work by treating them as passive recipients of mandates. Even the term “professional development” conveys that teachers are “deficient and in need of developing and directing” (Webster-Wright, 2009, p. 712). Aileen Kennedy (2005) argued that traditional PD initiatives rarely are designed based on how teachers learn, but are instead built on the premise that highly effective teaching results from mastering a set of technical skills. As a result, many teachers believe that the PD available to them is not useful (Darling-Hammond et al., 2009) or does not meet all of their professional needs (OECD, 2014). Where might teachers turn when their professional growth is stunted by poor traditional PD or school environments that fail to meet their needs?

Many teachers engage in different forms of informal PD, including study groups, Edcamp unconferences, classroom observations, and conversations with colleagues (Trust, 2015; Carpenter & Linton, 2016; Desimone, 2009; Eraut, 2004; Kynt, Gijbels, Grosemans, & Donche, 2016; Richter, Kunter, Klusmann, Lüdtke, & Baumert, 2011). Unlike traditional PD that often is driven by narrow aims, these more informal professional learning experiences can support the holistic needs of teachers. Informal learning opportunities allow educators to co-construct knowledge for their practice in collaboration with peers,

colleagues, and other individuals who are situated locally. However, such PD is less commonly studied than formal PD (Kynt et al., 2016). There thus remains a need for more “insight into how informal learning can be supported, encouraged, and developed” (Kynt et al., 2016, p. 2).

In recent years, many educators have begun to access online spaces to extend their informal learning activities into the digital realm. Jenkins, Purushotma, Weigel, Clinton, and Robinson (2009) described online spaces in particular as “ideal learning environments” (p. 10) because they offer peer-to-peer learning with participants who engage in various ways according to their interests, skills, expertise, and needs. Moreover, Gee (2004) contended that digital tools can support informal learning by connecting people with similar interests who become more accessible because of reduced temporal and spatial constraints. These concepts of participatory cultures (Jenkins et al., 2009) and affinity spaces (Gee, 2004) help explain the types of informal learning that occur in PLNs.

3.2. Personal/professional learning networks

Tobin (1998) coined the term “Personal Learning Network,” to describe a network of people and resources that support ongoing learning. While the terms *Professional Learning Network* and *Personal Learning Network* are often used interchangeably, we use the term “Professional Learning Network,” or PLN, because this study focused on teachers’ learning related to their professional work. According to Tobin, employees can learn by observing and talking with their network of colleagues and with individuals who have relevant expertise. He asserted that, “learning doesn’t take place just in training programs, but should be part of every employee’s everyday activities. You learn every time you read a book or article, every time you observe how someone else is doing work similar to your own, every time you ask a question” (Tobin, para. 1). Tobin thus defined PLN learning as an ongoing and multifaceted process.

PLNs can be understood as learning systems built upon an architecture of participation that can come to exist with or without specific objectives. In such systems “learning is understood in terms of ongoing, recursively elaborate adaptations through which systems maintain their coherences within dynamic circumstances” (Davis, 2004, p. 151). Individual agents engage in these systems through various forms of participation - from committed engagement to more peripheral lurking - that are generally transactional in nature. In other words, as people participate in a system, they change it, and the system changes them. The responsive nature of PLNs might offer teachers access to interactions and resources necessary to grow professionally.

Many researchers and educators have attempted to define and envision the purpose of PLNs for teachers (e.g., Couros, 2010; Flanigan, 2011; *Powerful Learning Practice*, 2012; Trust, 2012), but there is no agreed-upon definition. PLNs have been described as “reciprocal learning system[s]” (*Powerful Learning Practice*, 2012, p. 8), “vibrant, ever-changing group[s] of connections,” (Crowley, 2014; para. 4), “network[s] of fellow educators and resources” (Catapano, n. d.), “the sum of all social capital and connections” (Couros, 2010), and “online communities that allow the sharing of lesson plans, teaching strategies, and student work, as well as collaboration across grade levels and departments” (Flanigan, 2011). Various scholars, authors, and educators conceive of PLNs in unique, and somewhat disparate ways. Prior to this study, researchers had yet to examine how teachers themselves defined and described their PLNs. Understanding how educators conceive of and utilize PLNs may help bring more clarity to the construct.

PLNs offer new spaces in which teachers may learn and grow as professionals with support from a diverse network of people and resources. With recent advances in technology and widespread access to the Internet, teachers can expand their web of connections beyond their face-to-face networks, seek help and emotional support, and aggregate vast quantities of professional knowledge at anytime and from anywhere (Hur & Brush, 2009; Trust, 2012; 2013). PLNs can also be differentiated from online communities, networks of practice (Brown & Duguid, 2000), and social media sites. Online communities are groups of people who connect for a shared purpose, while a network refers to a, “set of nodes and links with affordances for learning” (Wenger, Trayner, & de Laat, 2011, p. 9). Social media sites are digital tools that people can use to connect and communicate with others. Each of these terms refers to a single medium for connecting with others. PLNs are broader, multifaceted systems, that often incorporate multiple communities, networks of practice, and sites that support both on- and off-line learning. Researchers have yet to explore PLNs as complex systems of people, resources, and digital tools.

Even though educators seem to be giving PLNs more attention, there is a dearth of research about PLNs and their effects. The majority of studies about online teacher learning focus on the learning experiences of the teachers in a single community, network of practice, or site, such as Twitter (Carpenter & Krutka, 2014; Gesthuizen, 2012; Hur & Brush, 2009; Kelly & Antonio, 2016; Trust, 2015; Visser, Evering, & Barrett, 2014). Similar to PLNs, teachers participate in these online spaces in order to find, share, and create professional knowledge (Carpenter & Krutka, 2015; Trust, 2015; Duncan-Howell, 2010; Forte, Humphreys, & Park, 2012), and to collaborate with and feel supported by a community of education professionals (Carpenter & Krutka, 2014, 2015; Hur & Brush, 2009; Visser et al., 2014). Some researchers have also explored how participation in online spaces shape teachers’ identities (Barab, Kling, & Gray, 2004; Luehmann & Tinelli, 2008).

While some academics have explored the immediate, potential, and applied value of certain online communities and networks (Wenger et al., 2011; U.S. Department of Education Office of Educational Technology, 2014), there is still a significant gap in the literature regarding the value of PLNs and how they shape teaching and learning. Given the limited nature of research about PLNs, in this study we sought to further understandings of teachers’ experiences with PLNs. In addition to inquiring about demographic data and details on PLN mediums in our survey, we asked educators to answer a set of prompts that were aligned with our research questions:

- How do P-12 teachers describe their PLNs?
- What do teachers learn from PLNs and how do they believe their PLN activities affect their teaching?
- How do teachers perceive that participation in PLNs affects their students' learning?

4. Methods

From the outset of this qualitative study, our purpose was not to find generalizable laws that apply to all educational settings. Teachers' lived experiences are characterized by diverse and changing classrooms and communities, shifting technologies, and varying standards. Research that ignores contextual factors runs the risk of misapplication and can even be misused to disempower teachers (Cochran-Smith & Lytle, 1991). Instead, we aimed to investigate how many teachers conceive of and experience PLNs so as to offer insights to researchers, teachers, and other interested parties. Furthermore, the online environments that are an important part of teachers' PLNs offer a "moving target" where "it sometimes feels as if the social media landscape changes too quickly to fully grasp and leaves scholars permanently lagging behind" (Hogan & Quan-Haase, 2010, p. 309). Because of this rapidly evolving environment, we did not focus on specific tools but instead on educators' purposes that were likely to persist even as the popularity or nature of certain online platforms or services changed.

4.1. Instrument

We drafted, discussed, revised, and finalized an online survey to collect qualitative data about educators' PLNs (see Appendix 1). Existing PLN literature (e.g., Wenger et al., 2011) and our own experiences with PLNs informed our survey design. The final survey was made using a commercial survey creation tool and consisted of three sections concerning informed consent, demographics, and PLNs. Electronic survey quality design criteria, as suggested by Andrews, Nonnecke, and Preece (2003), informed our survey construction. All respondents were asked to fill out a grid to describe the frequency of their professional use of various digital tools, but depending on their professional roles, the other PLN items varied slightly. Educators without teaching responsibilities (e.g., principals, curriculum facilitators) were asked to answer three open-ended prompts, while educators with teaching responsibilities received an additional open-ended prompt and one close-ended question. This article explores the responses from those respondents with teaching responsibilities.

4.2. Data collection

Because we set out to explore the nature and impact of PLNs, rather than trying to determine how common they are among the teaching profession, we did not attempt to use a random sample of teachers. Furthermore, as the PLN concept is still emerging and unfamiliar to many educators, trying to construct a sample from a particular school or district for the survey would likely result in a large number of potential respondents being unfamiliar with the concept of interest. As a result, we specifically targeted our survey at educators who were likely familiar with the idea of a PLN. After we secured IRB approval to conduct our study, we posted invitations to a variety of online spaces during seventy-five days in the fall of 2014. These online spaces were primarily selected because they were popular tools in the PLN literature and we were familiar with them from our previous research and professional activities. There was also a degree of snowball sampling (Baltar & Brunet, 2012) in that we posted invitations to some online spaces because early survey respondents mentioned them as sites of PLN activity. Snowball sampling has been commonly used in research on voluntary social media activities where it is challenging to gather random samples (e.g., Baltar & Brunet, 2012; Carpenter & Krutka, 2014; Fewkes & McCabe, 2012; Visser et al., 2014). We attempted to mitigate the biases associated with snowball sampling by posting to a variety of spaces.

We sent the most invitations to our survey via Twitter (see Fig. 1) by directly inviting responses from our approximately 5300 combined followers, and including a variety of education-related hashtags (e.g., #edchat) and hashtags associated with various international-, national-, and state-level education conferences that occurred during our data collection process. Such hashtags serve as digital "affinity spaces" (Gee, 2004) where individuals with similar interests can convene to engage in conversation, mentoring, and resource sharing. In addition to Twitter, we posted multiple invitations to a variety of other

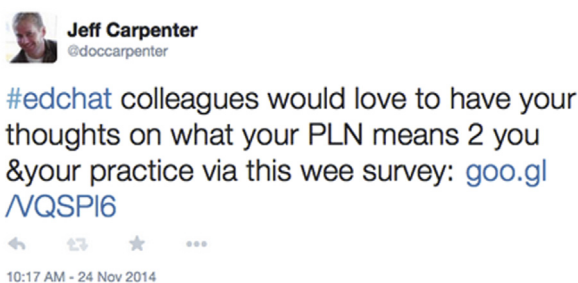


Fig. 1. Screenshot of request for participation tweet.

online spaces utilized by educators for professional purposes, such as Edmodo and Schoology (see Table 1). While we most actively used Twitter to solicit respondents, tweets generally hold less permanence than posts on other mediums. For example, while a tweet may be viewed primarily within a few hours, a post in an Edmodo subject community may be viewed over the course of days or weeks. Across these sites, we distributed the survey invitation systematically at different times of the day throughout the week so it would be visible to a broad range of educators in various time zones and with different online habits. We closed the survey when the rate of responses per day began to decline in relationship to the number of invitations posted.

4.3. Sample

A total of 1417 educators responded to the survey. A little more than half of the respondents ($n = 732$) reported that they were P-12 teachers. However, our survey did not require participants to respond to every prompt, so the number of P-12 respondents for individual prompts varied slightly. The majority of the P-12 teachers were female ($n = 541$; 74%) and lived in the United States ($n = 562$; 77%). Participants resided in 47 different countries including Canada ($n = 38$; 5%), Australia ($n = 21$; 3%), the United Kingdom of Great Britain ($n = 14$; 2%), Indonesia ($n = 5$; 1%), Serbia ($n = 5$; 1%), the Philippines ($n = 4$; 1%). Eighty-six percent of the respondents were between 25 and 54 years of age, with smaller percentages at the younger and older extremes (see Table 2). Participants' years of teaching experience ranged from 0 (new teachers) to 43, with an average of 14.52 years of teaching experience. More than two-fifths of the participants were high school teachers ($n = 308$; 42%). The remaining participants consisted primarily of teachers in middle school settings ($n = 184$; 25%), elementary settings ($n = 185$; 25%). Eight percent of respondents taught multiple grade levels from prekindergarten to 12th grade (e.g., PreK-8, PreK-12, 4–8). The participants reported teaching a variety of subjects (see Table 3). The demographics of the sample may have been influenced by the data collection method in that respondents from our existing professional networks may have been more likely to see and/or respond to the survey invitation.

4.4. Data analysis

We conducted a thematic analysis in order to identify and explore patterns that traversed the research questions. Braun and Clarke (2006) listed the following six phases of thematic analysis: becoming familiar with the data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, producing the report. To become familiar with the data and develop our code structure, we engaged in repeated iterations of individual coding followed by comparison and discussion of interpretations. In total, we engaged in seven cycles of coding that included regular research team meetings to discuss the data and coding structure.

We began by independently reading and rereading the responses from the first 200 P-12 teachers who completed the survey to identify patterns and themes, and develop initial codes and categories. We then compared our memos and code sets. Initial code sets ranged in size from 17 to 60 codes. Through discussion, comparison, and consolidation we were able to tighten our coding structure to produce 35 tentative codes. Because of the interrelated nature of our questions, numerous codes bridged multiple prompts. We then individually recoded the first 200 responses with the new code structure. At this point we again compared our individual coding to address and reconcile differences of interpretation. Next, we video-conferenced in order to synchronously code and discuss a new group of responses. Data receiving the same codes were

Table 1
Sites of online recruitment.

Site	Online spaces	Examples	Number of invite posts
Twitter	200 + hashtags	#edchat, #edtech, #ce14	1-6 per hashtag
Edmodo	12 groups	Math, Science, English, History groups	5-6 per group
Google +	9 communities	Educational Technology Community, Connected Learning Community	1-2 per community
LinkedIn	9 groups	21st Century Education group, Social Studies Education group	1-2 per group
Facebook	7 groups	New Teacher Chat group, Connected Educator Month group	1-2 per group
Edweb	7 communities	Emerging Technology community, PD in Action community	1-2 per community
Schoology	7 groups	Professional Development group, Science group	2-3 per group

Table 2
Participants' ages.

Age	% Of participants
18–24	2%
25–34	23%
35–44	36%
45–54	26%
55–64	12%
65 or over	1%

Table 3
Subjects taught by participants (N = 732).

Subject	n
English/Language Arts	276
History/Social Studies	265
Science	246
Math	215
Computers/Technology	188
Creative Arts (e.g., art, music, drama)	86
Health/P.E.	79
World Languages (e.g., Spanish, French)	72

Note. Participants were asked to select all of the subjects they taught. Nineteen other subjects were mentioned by 16 or fewer respondents.

sorted and compared to both refine the codes and consider similarities and differences in respondents' comments. Codes were then reconsidered, resulting in a revised set of 36 codes (see Tables 4–6 for the three codebooks related to the three research questions). We then divided the questions so that two of us were responsible for coding each of the four questions. The full corpus of data was reread and coded again with the revised code set. We remained open to the possibility that later responses might suggest the need for additional or modified codes, but in the end this need did not arise. Given the interpretive nature of the type of qualitative coding we conducted, we opted to rely upon intensive group discussion and group consensus to reach agreement upon codes, rather than on an inter-rater reliability statistic (Saldaña, 2012; Sandelowski & Barroso, 2007).

We then prepared an initial report for each of our four prompts. These reports included analysis of code frequencies and exemplars of data that represented each code. We discussed each report in individual meetings before convening further meetings to analyze the reports together and consider how they related to each other. Upon exploring the reports for prompts

Table 4
Research question 1 codebook.

Code	Description	Example
Single	Participant described PLN as a singular component.	"My most effective PLN is #psychat. We meet on Twitter Wednesday nights at 9pm."
Singular/Multifaceted	Participant described PLN as a multifaceted singular component.	"Twitter is the #1 PLN for me!!!#pegeeks/#wateachlead/#TPEPchat/#iPadsinPE "
Multifaceted Face-to-Face	Participant described PLN in terms of multiple face-to-face components.	"I have several different ones./current team/current grade level subject area(s)/School wide subject area/Then there's all the people I interact with from a variety of places."
Multifaceted Unknown	Participant described PLN in terms of multiple components; however, the participant does not indicate whether the PLN is online, face-to-face, or blended.	"My PLN has 2000 + members and range from teachers/administrators to artist/musicians to Congress and members of the media. I learn from all of them."
Multifaceted Blended	Participant described PLN in terms of multiple face-to-face and online components.	"1) The faculty in my own school building who I collaborate with face-to-face daily/2) Colleagues in my own school district who I communicate with face-to-face occasionally but mostly through email/3) Educators from all around the world who I communicate with via an ongoing Skype chat group called HLWSkypers."
Multifaceted Online	Participant described PLN in terms of multiple online components.	"I am a member of several online communities that I use for professional learning – LinkedIn, edWeb, edmodo, Follett Learning community. I also use Pinterest and Delicious to bookmark sites that I like and want to remember."
Technology	Participant described the digital tools they used and/or online communities they engaged in as part of their PLNs.	"Schoolology (Schoolology Educators, 1 to 1 Computing, Flipped Classrooms, Blended Learning)/Google Classroom/Google+/LiveBinder/YouTube/TeachersPayTeachers"
People	Participant described the people (local and online) in their PLNs.	"My colleagues as well as art educators from around the globe are part of my PLN"
Why	Participant described reasons for having a PLN.	"I find meeting with other librarians is my most valuable tool for finding professional knowledge, whether it is by attending webinars, meeting face-to-face, or by reading professional journals, tweets and blogs."
How	Participant described how he/she engaged in learning with his/her PLN.	"I generally find professional knowledge in the following ways: participate in Twitter chats, read blogs, reflect and write daily/attend conferences and courses, talk to colleagues."
Other	Participant described a PLC, local PD, or other learning activity that did not seem to fit the definition of a PLN.	"Currently, our school is divided up into 5 separate PLNs. Each PLN has about 10 teachers and the groups are mostly cross-curricular."

Table 5
Research question 2 codebook.

Category	Code	Description	Example
Affective	Emotion	Participant described how PLN makes him/her feel.	"I feel most importantly I am more energized as an educator"
Affective	Learning Dispositions	Participant described a change in habits, mindsets, or attitudes toward learning.	"My PLN helps keep me in check, allowing me to reflect and continue to have a growth mindset for my own learning journey."
Affective	Confidence	Participant showed an increased willingness to take risks and try new things.	"Connecting with others has given me the tools, resources, ideas, lessons, and confidence to reach out to others and try new things."
Identity	Reflection	Participant felt that he/she became a more reflective practitioner.	"Being connected has allowed me to ask questions, be more of a reflective practitioner and be a better educator."
Social	Being Part of a Professional Community	Participant discussed the value of having a community of educators and/or emphasized the importance of sharing with a larger community.	"I love sharing my ideas and the more I am able to share, I find it even more meaningful to spend time making great lessons not only for my students to benefit from, but students of my PLN."
Social	Global	Participant described instances of connecting his/her classroom with a broader global community.	"I am... able to share a more connected community with my students – tweeting authors, skypeing with other classrooms, having teachers around the globe comment on student blogs, etc ..."
Cognitive	Education Philosophy	Participant described a shift in thinking about his/her own teaching practice.	"My teaching has changed drastically over the last 30 years. I've moved from a teacher-centered classroom to a student-centered classroom."
Cognitive	Teaching Strategies	Participant described one or more teaching strategies.	"I have been able to develop and implement teaching practices such as literacy circles, daily 5, inquiry and genius hour very quickly with the confidence to draw on the experience and expertise of my PLN."
Cognitive	Assessment	Participant described changes to the way he/she assesses student learning.	"I have changed my outlook especially on assessment, incorporating project based learning and performance assessments and even adapted my grading to be more positive for learners."
Cognitive	Technology	Participant described using new/more technologies in the classroom.	"Via my PLN, I brought 'Bring Your Own Device' BYOD to my school. Using technology for learning 24/7 is so important. We always refer to the cell phone or tablet as a 'personal learning device.'"
Cognitive	Engagement	Participant described teaching strategies that were focused on engaging and motivating students.	"I have implemented both Project Based Learning and 20Time to name a few. Student engagement has increased."
Cognitive	Professional Knowledge	Participant described acquisition of knowledge useful to their professional role but not directly related to teaching strategies.	"I have learned about the myriad changes to our standards, evaluations and testing conditions almost daily from our OKMath Facebook page and from #oklaed."
Cognitive	Efficiency	Participant described ways in which he/she made teaching more efficient or streamlined.	"I am teaching paperless and with more technology involved. Things have become more streamlined and organized for me!"

Table 6
Research question 3 codebook.

	Code	Description	Example(s)
Affective	Learning Disposition	Participant described a change in students' habits, mindsets, or attitudes toward learning.	"My students are more positive and proactive related to learning. They get what it means to be a learner today. They have ownership of their learning."
Affective	Engagement	Participant described a change in student interest and/or participation.	"Student display a high interest in learning."
Affective	Confidence	Participant described how students were more confident and willing to try, fail, and make mistakes.	"My students are more confident in Spanish and are not as afraid to make mistakes."
Affective	Effort	Participant described how students showed an increased effort in learning.	"Many of my students are having discussions or posting assignments long after regular school hours."
Cognitive	Learning Outcome	Participant described changes in student academic achievement or behavior.	"Students have improved their writing and multiple choice AP test scores."
Cognitive	Reflection	Participant described how students became more reflective learners	"My older students sometimes ask to see my lesson plan so that they can evaluate their own learning process."
Cognitive	Independent Learners	Participant described how students became more independent, responsible, and/or empowered.	"They have become independent thinkers and learners."
Cognitive	Creativity	Participant described how students became more creative thinkers and/or producers of content.	"My students are more creators than consumers because of my PLN."
Social	Connectedness	Participant described how students are connecting and collaborating with others.	"My students have become more globally and culturally aware and love to share their creations with students and professionals around the world."
Other	Unknown	Participants are new to PLNs and/or the impact on student learning is unknown.	"I frankly don't know. The changes I have made are fairly recent."
Other	Teacher-Centered	Participant described something other than student learning or focused on teacher-centered changes.	"My students are exposed to ideas and methods that they may never have been exposed to before."

two, three, and four, we identified four broad themes that spanned the three questions and 36 codes: affective, social, cognitive, and identity. We engaged in member checking (Lincoln & Guba, 1985) our findings with thirteen participants who had voluntarily provided their e-mails and responded to our request for feedback. We incorporated their feedback into our analysis and discussion.

5. Findings

As we analyzed our data and identified themes, the variability of responses to our questions stood out. Teachers both conceptualized PLNs and described utilizing them in an assortment of ways. Additionally, teachers sometimes offered unexpected answers that seemed to venture beyond the scope of our questions. However, within the complexity of teachers' responses, we identified four themes - affective, social, cognitive, identity - that offer understandings of the benefits teachers attribute to PLN activities. In this section, we will describe how and why PLNs mediated professional growth. We will report on teachers' conceptions of PLNs, detail what teachers learned from PLNs and how that learning affected their practice, and then convey how respondents believed PLNs affected students' learning.

5.1. Research question 1: how do P-12 teachers describe their PLNs?

Of the 732 P-12 teachers who completed our survey, 537 provided descriptions of their PLNs. Responses varied significantly, as some educators defined their PLNs in terms of tools, platforms, resources, sites, people, or some combination of these elements. Teachers' described PLNs as everything from engaging in an activity with a single component (e.g., participating in a Twitter chat) to a multifaceted network of activities and components. For example, a middle school history teacher described a quite complex PLN:

My PLN consists of 4 main components and a number of secondary components. My main components are another social studies teacher, Twitter (specifically edchats and #TNFlipchat, #edcamp, #gbl, and the 20 or so people I follow), Edutopia, my instructional support coach. My secondary components are my other teachers I work with, my former instructional [coach], my former colleagues, Google searches for specific topics.

This exemplifies the combination of people and tools that comprised many participants' PLNs, but also offers a contrast to responses where teachers identified their PLN as a single object or component. While it is possible that a PLN consisting of a single component could meet the professional needs of some educators, teachers might benefit from exploring whether more multifaceted and diverse networks could better help meet their holistic needs over time.

Approximately, 90% ($n=474$) of the 537 PLN descriptions were coded as "multifaceted." Forty-seven percent ($n=223$) of these multifaceted responses incorporated both face-to-face (e.g., school colleagues) and online components (e.g., webinars), while 38% ($n=180$) solely centered on online elements, and 1% ($n=3$) described only face-to-face elements. In 14% ($n=68$) of the multifaceted responses, the teachers did not specify whether their PLNs were online, face-to-face, or a blended combination of the two. Also, it is worth noting that our participants rarely described their PLNs passively as something done to them, as can often be the case with traditional PD (e.g., "I attended a workshop after school"), but they instead spoke with a sense of ownership and agency about their personalized networks (e.g., "my PLN").

5.1.1. People

Even though descriptions of PLNs varied widely, the majority of the 537 respondents to this prompt remarked on the people who were part of their PLNs (71%; $n=381$). Descriptions of people included both specific people and types of individuals. Teachers listed individuals in their local networks (e.g., co-workers, administrators, graduate school peers), educators from across the globe with specific expertise (e.g., fourth grade teachers, technology specialists), and people who worked outside the field of education (e.g., writers, scientists).

Many of our respondents described the people in their PLNs as diverse and numerous. A U.S. elementary school teacher shared, "my PLN is made up of an eclectic mix of people: educators, farmers, gardeners, politicians, programmers, those both inside and outside of the education field. I am better because I can learn about things from all different sides." Another respondent described how her PLN included diverse parties who could help her meet her goals:

Other educators are in my PLN. They may be people who teach similar things, technology coaches (a job I aspire to hold one day soon), principals, Edcamp leaders ... and more. I also follow many companies and education-related organizations to stay updated on their products, which also helps inform my teaching.

These two teachers' PLNs incorporated a blend of individuals that potentially allowed access to more diverse perspectives than would have been available within their local communities.

Many of our respondents highlighted the global nature of their often sizeable PLNs. A high school English and social studies teachers stated, "I have a tremendous PLN of design thinkers across the country and globe with members active in the US, Canada, New Zealand, Australia, the UK, Brazil and in other corners as well," and an elementary school teacher from India wrote, "my PLN comprises of a few of my colleagues and the hundreds of teachers across the globe whom I follow on Twitter." An Australian elementary teacher shared, "I have thousands of people in my PLN," while a Canadian teacher stated that his PLN consisted of "about 1700 educators." While teachers often spoke of their global networks, they tended to primarily

mention colleagues in English-speaking countries with relatively more similar cultures. However, there were parts of the world (e.g., many countries in Africa, Latin America, and Asia) that went unmentioned, and there was limited evidence that participants gained the type of deep cross-cultural knowledge necessary for global citizenship.

5.1.2. Technologies

The creation of such large professional networks by educators is facilitated by platforms like Twitter, Facebook, and Edmodo that make it easier for teachers to develop connections with people both far and near. Ninety-four percent ($n = 503$) of the participants listed digital tools they used to cultivate their PLNs. The most popular tools in our sample were: Twitter (53%; $n=284$), Edmodo (26%; $n=141$), blogs (25%; $n=135$), Google+ (17%; $n=92$), Facebook (17%; $n=92$), Discovery Education Network (13%; $n=67$), and Pinterest (12%; $n=63$). The majority of participants (84%; $n=451$) listed more than one medium or site. For example, a high school teacher from Mexico wrote that his PLN consisted of “Twitter edchats and English Companion Ning. #aplitchat, #mexedchat, #engchat, MindShift, ECN, Edutopia, Facebook Intl Teachers Group.” This teacher’s PLN spans multiple platforms including Twitter, Ning, and Facebook, which exemplifies our conceptualization of a PLN as a holistic network that incorporates multiple platforms, communities, and spaces. Teachers who listed a single medium often reported engaging with that medium in different ways (e.g., participating in a variety of Twitter chats or joining multiple subject communities in Edmodo).

In addition to listing technologies, many teachers (47%; $n = 251$) also described how they used these tools. This included following blogs, participating in Twitter chats, using virtual conferencing tools to talk in real time, and using social bookmarking tools to collect resources. A U.S. middle school teacher wrote, “My PLN ranges from a colleague in Hong Kong to other teachers near and far. We use Google Hangouts, Google Plus communities, and Twitter the most. I use Twitter chats a lot to be connected and share and receive ideas.” This teacher, like many of our participants, mentioned using a variety of tools in order to connect and learn with others.

5.1.3. Motivations

One-third of the respondents explained why they participated in PLNs. These participants provided reasons such as “curating information,” “exchanging opinions,” “[staying] current on research and best practices,” “collaborat[ing] with experts,” and “networking with teachers.” Several teachers also mentioned that their PLN inspired them to become better teachers and provided support when they needed help. A U.S. high school Language Arts teacher shared how and why she participated in multiple networks as part of her PLN:

I work with PLNs on 3 arenas—school, Twitter, and Facebook. School PLN gives me the opportunity to work closely with colleagues to develop lessons and ideas of how to approach students and get them engaged in the literature. Twitter PLN offers global connections and perspectives. Facebook PLN offers me a comfortable place to discuss successes and failures, challenges and wins. I participate in 30 day challenges on Talks with Teachers which helps to set goals and take those goals from ideas to fruition.

This teacher spoke to the multiplicity of reasons for PLN activities as she referenced how her activities at school and via two digital platforms helped sustain her professional growth. However, this teacher’s articulation of her “PLNs” as being partitioned by platforms, not interconnected components of a PLN akin to our holistic description, provides further demand for a coherent definition to serve as a foundation for practice and research.

Overall, the teachers described an array of means and purposes for utilizing PLNs. Respondents characterized PLNs as face-to-face, online, and blended in nature. Some teachers identified the people in their PLNs, while others listed only the web-based tools they used and the social networking sites they joined. Some respondents expressed why they participated in PLNs, and others explained how they participated. Yet, even though there was significant variability in the teachers’ responses, the majority of teachers described their PLNs as systems of people, resources, and digital tools that supported and facilitated their ongoing learning and professional growth. The complexity and flexibility of these systems seemed to empower teachers with a variety of needs and interests as they adapted and evolved their practice.

5.2. Research question 2: what do teachers learn from PLNs and how do they believe their PLN activities affect their teaching?

A total of 507 participants described how their PLN activities shaped their teaching and learning. Given such disparate conceptions of PLNs, it is perhaps unsurprising that respondents also indicated that myriad changes to their learning and teaching resulted from PLN activities. Some teachers learned about and implemented specific teaching strategies, while others redefined their roles and aims as teachers. The participatory learning afforded by PLNs supported the varied affective, social, cognitive, and identity development needs of whole teachers as they grew in their craft.

5.2.1. Affective

Many teachers described PLNs as influencing their emotions, interests, and attitudes related to teaching and learning. Eighteen percent ($n = 91$) of the 507 respondents to this prompt mentioned that PLN activities positively affected their feelings about teaching and learning. These respondents used words such as “energized,” “engaged,” “inspired,” and “invigorated” to describe how connecting with and learning from others rekindled their passion and excitement for teaching. A U.S. high school social studies teacher commented, “The most important resource I get from my PLN is inspiration and

energy. When I'm not getting [it] at school, I can turn to a like-minded group of people online and get fired up about teaching again." Additionally, a U.S. English and Arts teacher commented, "I have more compassion and am excited about teaching again. I like using new information and I do not feel alone in my adventure called teaching."

Not only did PLNs seem to invigorate some respondents, but also a handful of educators indicated that their PLNs were integral to supporting their persistence in the teaching profession. A high school teacher in the U.S. confessed, "If I didn't have my PLN in place to support and encourage me online and in real life, I know I would not be teaching in a classroom today." Another respondent said she "was getting burned out... and this has helped inspire me to keep trying... and try something new!" Teacher retention and burnout have long been critical issues in the field, so it is noteworthy that some of our participants cited their PLNs as inspiring persistence and engendering rejuvenation.

A number of participants ($n=175$; 35%) also described transformations in their attitudes about teaching and learning because of their PLNs. Some of these respondents' ($n=29$; 17%) reconceptualized their work as ongoing, not static. For example, a U.S. World Languages teacher stated that she had learned from her PLN to "always keep learning, researching, and trying new things," and a high school technology teacher from Jamaica wrote, "teachers have to be willing to be students. Constantly. Consistently. Currently." An elementary teacher from South Korea shared that his teaching had "opened up to experimentation, iteration and innovation." For these respondents, PLNs served to make teaching a continuous and recursive process.

Fourteen percent ($n=71$) of the 507 respondents mentioned that their PLNs helped them become more confident teachers who were willing to take risks, make mistakes, and learn from failures. For example, a middle school science and technology teacher shared, "I have become more of a risk taker and not afraid to fail. That allows my students more unique learning opportunities." A U.S. computers/technology teacher described overcoming a lack of support in her school to gain the confidence to make changes in her practice:

I have been willing to try new ideas and techniques in my classroom. I have gotten comfortable with doing things that are out of the comfort league of the teachers on my campus. I have embraced the idea of F.A.I.L. or First Attempt In Learning. My students are learning that things may not always go the way we planned the first time, but that is ok. We adjust and try again.

With the support of their PLNs, these teachers testified to gaining confidence as professionals who were willing to try, fail, and adapt as they saw fit.

Twenty-two participants (4%) also noted a shift in mindset from passively awaiting training towards active ownership of their professional growth. A U.S. high school science teacher reported that she learned through her PLN that, "I am responsible for my own self advocacy when it comes to my professional development." Similarly, a high school humanities teacher commented that he had "learned that the most valuable PD for my teaching vocation does not (and never has) come from my local school district and administrators." PLN experiences appeared to encourage some of our participants to take more active roles in their own PD.

Overall, many teachers reported that their PLN participation inspired positive affective changes that contributed towards their professional growth. Some respondents indicated that their PLN connections helped sustain success, while others reported becoming more positive or confident practitioners who were willing to take risks in their classrooms. PLN engagement also seemed to arouse professional reflection about the very nature of teachers' work with many respondents championing a more active role as recursive learners.

5.2.2. Social

When asked to describe how PLNs influenced their teaching and learning practices, 49% ($n=248$) of the respondents to this prompt cited their PLNs as mediating various social benefits through connecting, collaborating, and communing. Respondents identified various benefits of connecting and learning with professionals who often extended beyond the geographic boundaries of their school experiences, including overcoming isolation, being exposed to and interacting with diverse perspectives, and collaborating with other educators.

While we asked specifically about PLN influences on teacher learning and practice, 21 participants (4%) explicitly mentioned how their PLN helped combat isolation. These teachers named various types of isolation, including geographic, content area, grade level, learning disposition, and educational philosophy. A teacher of an elective subject "with no team or grade level to work with" at her school site explained that thanks to her PLN, "I am able to bounce ideas around with other teachers." Teachers also described PLNs as combatting isolation associated with differences in educational philosophy or disposition. A health/P.E. teacher from Canada shared, "I learn most about inquiry based or student centered learning on Twitter because there are few people using inquiry in my school." Through her PLNs, this teacher was able to connect and learn with educators with specific educational values, philosophies, or expertise that could abate various forms of isolation.

New technologies such as social media have been criticized for allowing individuals to surround themselves with people and ideas that agree with their existing beliefs. A small subset of our data ($n = 6$; 1%) supported these criticisms. For example, an educator from Qatar wrote: "there is always someone out there who thinks the same; they may not be in the same school but they are out there." Teachers who use their PLNs to connect with people who think the same way risk creating echo chambers for validating their ideas rather than engaging in deep learning by considering diverse or contradictory perspectives.

On the other hand, eleven participants (2%) mentioned that the professional community available through their PLNs provided a variety of perspectives not readily available to them otherwise. An English-Language Arts teacher reported that her PLN afforded “varied perspectives on an issue or ways to teach or deal with problems that I would not have without the input from my PLN.” A P-12 teacher from Italy described how she “constantly experience[d] culture shock” because her PLN exposed her to “such a large variety of views and opinions, from people from all around the globe.” She went on to say that she was “completely transformed in [her] everyday pedagogical and leadership practices,” and this caused “a significant paradigm shift in all things cultural and educational.” By connecting with a broader professional community, these teachers were able to access and explore diverse perspectives in ways they deemed valuable.

Fifty-five participants (11%) noted that their PLNs provided opportunities for collaborative learning. For example, a high school technology instructor believed that teachers are better when they “rally together, sharing a common vision of helping our students become morally responsible and socially sensitive leaders in their communities.” Likewise, a U.S. elementary school teacher contended that PLN collaboration can both aid in “the enormous amount of activities and planning” and is “necessary to survive as a teacher.” Eschewing hierarchy for collaboration, a U.S. middle school teacher said that, “open is better: sharing and collaborating to grow professionally is more relevant than top-down requirements.” She continued, “from units and projects, to strategies and solutions, my PLN is a reciprocal neighborhood of learning to improve our profession.” Such respondents credited their PLN collaboration with supporting professional growth that might not have been possible in isolation.

Some teachers (10%; $n=52$) described ways that they could draw on their PLNs to connect their students to global networks. For example, a U.S. elementary school teacher wrote:

My students have opportunities to collaborate with others that I didn't even know existed before I became a connected educator and developed a global PLN. We have gotten to Skype with actress Joey King about anti-bullying, talk to many authors, had science demos done for us by amazing science teachers in other states, taken virtual field trips to many places we wouldn't normally get to visit, such as the Arctic tundra or an egg farm. I was encouraged to have my students blog and they received comments from around the globe thanks to the hashtag #comments4kids.”

Through her PLN, this teacher found innovative ways to extend the social benefits of learning to her students.

Our respondents indicated that the sociality of PLN activities helped reduce isolation, offer unique perspectives, encourage collaborative learning, and served to connect students to global audiences. These benefits seemed galvanizing and one high school science teacher even attributed her PLN activities as bringing her to “the beauty of empowerment within my profession.” She went on to say that PLNs “maintain dignity in the profession with pride in what we are doing because we are connected to a network of like minded professionals.” The access to peers from outside traditional school or district professional circles offered many of our participants a broader community of professionals who encouraged growth and camaraderie.

5.2.3. Cognitive

Many teachers communicated various cognitive benefits associated with their PLN activities, including areas of knowledge (e.g., ideas, resources, teaching strategies) and intellectual skills (e.g., application of knowledge to practice, reflective practice). Sixty-eight percent ($n=346$) of the participants who described changes in their teaching and/or learning reported acquiring new knowledge from their PLNs. A teacher from South Korea “learned about the Plickers app and QRD survey cards, which makes getting real-time student feedback practical and affordable using your own smartphone.” Additionally, a U.S. middle school teacher indicated that the professionals in her PLN curated “many books, resources, teaching ideas, etc. I can get actual ways to jazz up lessons, creative ways to teach content, thought-provoking articles, and much more all at my fingertips without having to search in time consuming ways.” These respondents, like many others, located valuable new knowledge or resources through their PLNs.

Almost all participants (96%; $n = 487$) reported modifying teaching practices as a result of what they learned from their PLNs. A middle school science teacher commented, “I learned how to build a MakerSpace from a #satchat. I'm in the early stages of building the first MakerSpace in my school right now.” A high school social studies teacher wrote that she “learned so much about historical thinking, reading and writing practices from various Twitter users,” and she “uses the Stanford History Education Group's ‘Reading Like a Historian’ series that I learned about from Twitter, and all of their assessments as well.” These teachers honed their intellectual skills and applied knowledge and resources from their PLNs to their classroom practice.

Twenty-five percent ($n = 128$) of respondents reported that learning with people in their PLNs resulted in significant changes in the ways they reflected on and thought about teaching. An elementary school teacher with 25 years of experience wrote, “My PLN helped me early on with changing the way I look at and teach reading in the classroom,” and another respondent commented, “I have learned to rethink how I teach mathematics and reading after several webinars I attended online.” Additionally, a Canadian elementary school teacher wrote:

My PLN made me change my thinking about what good teaching is, what my job is and what I need to do to help students be successful in the long run. Education isn't about the next text or the next curriculum hurdle it is about developing a love of learning, a critical analytical mind, the ability to problem solve and to get along with others.

Through the blog posts and twitter feeds I have read I have come to realise that my job isn't just to teach kids to read and write but also to teach them to problem solve and grow as people.

Engagement with fellow professionals can instigate reflection upon practice and even reconsideration of goals. A high school teacher from Australia indicated that his PLN helped him see “what is possible and what is missing in my own practice.” PLNs offer educators’ windows into their peers’ work, which can provide mirrors for reflecting upon their own craft.

Our participants indicated that their PLNs provided support for cognitive growth that included gaining new knowledge, changing practice, and reflecting upon teaching. Participants were able to learn new teaching strategies, assessment ideas, or web-based resources, and develop their intellectual skills, which reportedly improved practice. Some of our respondents also indicated that they became more reflective practitioners who examined their teaching to see how they could improve and grow together with others in their PLNs.

5.2.4. Teacher identity

Identity was a theme that spanned affective, social, and cognitive aspects of teacher growth through PLNs. Approximately 34% ($n = 172$) of the 507 participants’ responses related to professional identity. Some teachers reported taking on new identities, such as “connected educators,” “lifelong learners,” or “teacher leaders,” while others detailed changes to their perspectives about the roles of educators. An Australian teacher valued being more public and transparent, saying, “I’m more open with my practice and learning process. I’m much more public with sharing ideas and resources. I encourage the same open reflective process with my students.” Additionally, a U.S. high school educator commented, “I am much more of a teacher leader because of the connections I’ve gained.” Rather than working behind closed doors, these participants shared their practices. Approximately 10% ($n=52$) of the participants mentioned that they learned how sharing is an important part of their role as educators.

Many of our participants (20%; $n=102$) also mentioned a shift in identity in relation to their students. These teachers identified their roles as facilitators, coaches, and guides often in contrast to simply being content knowledge experts. A music teacher commented, “I’m less of a ‘bandmaster’ or ‘choirmaster’ and more of a co creator,” and a science teacher from New Zealand wrote, “I concentrate less on delivering content and made it more about co-constructing the learning. From ‘sage on the stage’ to ‘guide on the side!’” These teachers credited their PLN activities with helping to shift their professional roles towards teacher-learners who co-constructed knowledge with students. Through interactions with their PLNs, our participants expressed that they were able to reflect upon and shift their identities as professionals in relation to their students, their schools, and broader professional communities of educators.

5.3. Research question 3: how do teachers perceive that participation in PLNs affect their students’ learning?

Of the total 732 respondents, 420 shared their beliefs about how PLN experiences shaped their students’ learning. Our respondents perceived alterations in terms of specific learning outcomes as well as changes in attitudes, mindsets, and practices for their students. In many ways, the changes teachers reported in their students’ learning mirrored the affective, social, and cognitive aspects of growth that our teachers reported through their PLNs.

5.3.1. Affective

Seventy percent ($n=294$) of the 420 respondents described how they felt their PLN activities influenced students’ emotions, interests, and attitudes. Many of these educators (38%; $n=160$) described their students with terms like “more engaged,” “more excited,” and “more positive” because of the changes they made to their practice. A Canadian high school teacher reported that she learned how to adopt an, “inquiry focus in my health lessons instead of collaborative or teacher-directed learning,” and as a result, she felt that her students were “more engaged and invested in their learning.” A U.S. high school teacher commented, “My students enjoy coming to class, and have positive attitudes about learning, which I attribute to the techniques I learned from my PLN.” These quotes are representative of many accounts of respondents who believed that their PLN activities contributed to their students displaying positive changes in feelings and interest in learning.

Additionally, 37% ($n=155$) of the respondents to this item reported that their students showed changes in attitudes about learning. Some of these teachers believed their students to be more confident learners and willing to take risks, while others noticed that their students were developing habits and mindsets reflective of experts in their fields. For example, a U.S. elementary school teacher who discovered constructivist teaching methods from her PLN noted that her students, “are active members of their learning team. They thirst for knowledge, they persevere, they see themselves as mathematicians and scholars.” This quote, like many others, exemplifies affective changes in students that purportedly contributed to their growth as learners. A few teachers also felt that their students’ attitudes about when, where, and how learning should happen shifted dramatically. A math, technology, and English/Language arts teacher from Australia noted that by modeling open and reflective learning with a PLN for his students, “they see the value in having their own personal learning networks. They see learning as something that can happen everywhere and all the time rather than just something that happens at school.” Akin to how teachers indicated that they utilized PLNs, our respondents believed their students were becoming more active learners also.

5.3.2. Social

Forty-two participants (10%) mentioned instances of their students collaborating and learning with peers in their classrooms and around the world. Examples of such collaborative learning included students supporting one another, building their own PLNs, connecting and learning with experts or people from different cultures, and leveraging digital mediums to extend conversations beyond class time. For example, a middle school English/Language Arts teacher shared, “Through Google Apps – which I learned through collaborating with my PLN, students now collaborate with each other, offering effective feedback for their writing,” and a high school art teacher commented, “Sharing, Discovering, Questioning, and Willing to Learn is part of being in a PLN which are some of the things that my students are doing in my classroom.” One respondent noted that connecting her students with global individuals increased students’ empathy:

An important change has been the level of empathy students have developed and shown. While this is not a learning outcome, it is directly related to their ability to problem solve through situations and devise meaningful solutions. A Skype conference with a teacher collaborator in Egypt during a time of unrest, prompted a conversation on censorship. A few students were very interested in this topic but felt they were not getting accurate information. They stayed up until 11 or 12 pm just to chat with a student from Egypt.

The social connections afforded by PLNs can encourage the development of worthwhile relationships and learning experiences for students, beyond traditional measurable academic gains.

5.3.3. Cognitive

Slightly over half of our respondents (54%; $n=227$) described changes in their students’ knowledge or intellectual skills with a majority of these responses (71%; $n=161$) centered on gains in the former. A U.S. middle school English teacher claimed that “using flipped instruction techniques found on Twitter has consistently increased unit test scores as well as standardized test scores,” and a U.S. high school English teacher attested that her “students have increased in their depth of understanding especially after adding lessons from EngageNY and Getting to the Core.” Both of these teachers cited PLNs explicitly as increasing students’ learning of content.

Twenty-nine percent ($n=66$) of the 227 respondents described the development of their students’ intellectual skills. Some respondents noted that students had become more reflective learners, while others mentioned that their students were learning how to learn. A teacher from New Zealand shared that by incorporating Mystery Skype in her classroom, which she had learned about from her PLN, she noticed that her 8- to 10-year old students were “engaging in higher order thinking by reflecting on their performance in the mystery skype challenges.” Additionally, a U.S. middle school teacher reported that through her PLN, she witnessed “other teachers incorporate reflection rubrics and so I [felt] empowered to do the same.” As a result, she noticed that her “students have been more reflective of their learning because of the types of activities I have given them and the fact that I ask them to reflect often now as part of an ongoing conversation on twitter.” These teachers, like a number of the participants, felt that the changes they made to their practice allowed their students to engage in activities that supported the development of their intellectual skills.

From understanding specific content to displaying educational dispositions to scoring better on tests, many teachers in our study believed that their PLNs positively influenced students’ growth. Teachers contended that students were more active, social, and empowered learners. In many ways, teachers’ descriptions of student changes mirrored the changes they saw in themselves.

5.3.4. Unsure or unclear responses

Even though teachers were overwhelmingly positive about the effects of their PLNs for their students, 19% ($n=78$) of the 420 respondents were either unsure or unable to describe how their PLN experiences shaped student learning. Some teachers (3%; $n=14$) confessed that they were uncertain whether their PLN experiences affected their students’ learning, while others (6%; $n=24$) stated a need to better assess educational impact. A U.S. high school math and science teacher wrote, “I don’t have any specifics yet [concerning the impact on student learning]. This has made me realize that I need to formalize this part of my lesson planning.” Some participants (2%; $n=8$) also mentioned that they were just starting to cultivate their PLNs, and therefore, they had yet to observed changes in students’ learning.

Additionally, 8% ($n=32$) of teachers either made vague comments indicating that, for example, students benefitted “from expanded opportunity to learn,” or they described changes to their own learning or practices instead of those for their students. A high school math teacher said that his “students are asked to analyze more deeply and engage more actively in the classroom as a result of the changes I have experienced as a teacher through online development and support.” This teacher described his students’ experiences through his own actions. While such teacher-centered explanations were not too common, it is worth further exploring the ability of teachers to accurately articulate various components of students’ learning. However, we believe that neither the small number of vague or teacher-centered answers, nor the difficulties in determining the complex learning effects of PLN activities, should supersede the overwhelmingly positive responses teachers offered concerning their PLNs.

6. Discussion

In this study we sought to respond to gaps in the literature related to teachers' uses of PLNs by examining teachers' conceptions of PLNs, effects of PLNs on educators' teaching and learning, and perceived effects on students' learning. While the multiplicity of teachers' responses were initially confounding, we quickly agreed that if teachers are active agents with diverse interests and needs, responding to and modifying their distinct and evolving contexts, then a diversity of data is fitting and ecological. While some teachers may have many of their needs supported within robust school communities and simply cultivate PLNs for lesson ideas and resources, others may turn to PLNs to nurture affective, social, cognitive, and identity aspects of their professional growth. Teachers' responses across questions left little doubt that they sought to be better teachers and their PLNs offered various means of doing so.

While past PD research has often focused on the effects of discrete programs, classes, or structures (Opfer & Pedder, 2011), many educators do not restrict their professional learning to isolated events or single modalities. Numerous respondents indicated that they accessed a wide variety of people, communities, and tools, in both traditional and non-traditional PD settings to further professional growth. A vast majority of participants' PLNs incorporated multiple digital tools, such as Twitter, blogs, and Facebook, which allowed the teachers to expand their connections beyond their local networks and seek knowledge and opportunities that might not otherwise be available. It is therefore important for those seeking to understand teacher professional learning in the 21st century not to become too focused on individual technologies – which will likely rise and fall in popularity – or isolated events (e.g., Twitter Chats), but to instead look at the overall nature and impact of educator PLNs. While we believe that there is merit to understanding how educators utilize single mediums or form particular communities, when trying to understand the broader professional growth of educators, we agree with Liu, Miller, and Jahng's (2016) concern that the search for a “single platform for community must end, whether that is understood in terms of software or social organization. Tools that work in one case will fail in another; tools that support community at one stage will hamper it at another” (p. 20).

Considering the diverse means for utilizing PLNs evident in our findings, we propose the following revised definition: PLNs are uniquely personalized, complex systems of interactions consisting of people, resources, and digital tools that support ongoing learning and professional growth. We believe this definition encompasses the diverse uses, understandings, and effects of PLNs, while being specific enough to offer teachers, administrators, and scholars a point of departure for dialogue and decision-making. While our revised definition aligns with Trust's (2012) description of a PLN as a “system of interpersonal connections and resources that support informal learning,” it also encourages researchers to examine PLNs as complex systems. According to Opfer and Pedder (2011), “Complex systems thinking assumes that there are various dynamics at work in social behavior and these interact and combine in different ways such that even the simplest decisions can have multiple causal pathways” (p. 378). We not only agree with this sentiment, but we believe that many of the teachers in our survey expressed it explicitly and implicitly in their PLN descriptions.

Our findings indicate that PLNs can provide myriad ways (e.g., online, blended, local, global) for teachers to grow based on individual and group needs. Considering that our prompts related to PLNs, which are often discussed in terms of digital features, we were somewhat surprised by how many teachers mentioned face-to-face PLN components. However, the enthusiasm for such blended professional learning that was common among our respondents is consistent with research that suggests beneficial effects of combined on- and off-line professional learning experiences for teachers (e.g., Donnelly & Boniface, 2013; Matzat, 2013). This reminds us to be careful about creating false dichotomies between online and face-to-face learning even when we conduct research focused on the digital realm. Jenkins et al. (2009) advised that instead of thinking of technologies in isolation, “we would do better to take an ecological approach, thinking about the interrelationship among different communication technologies, the cultural communities that grow up around them, and the activities they support” (p. 7). We recommend that educators and researchers keep in mind that not only do teachers change because of PLN engagements, but connected educators can influence face-to-face peers and even affect changes in the very platforms they use (See van Dijk, 2011 for example of the evolution of Twitter as a medium). Since PLNs are made up of complex, transactional learning environments, researchers should be mindful about the limitations of focusing on single aspects of PLNs and potentially losing sight of the forest for the trees.

The complex and shifting nature of educators' PLN experiences means that they can benefit in diverse ways. Because PLNs are multimodal and support anytime, anywhere learning, teachers have various avenues to develop their knowledge, skills, and identities as professionals. Previous studies have indicated that teachers participate in virtual communities and networks in order to find, share, and create professional knowledge (Forte et al., 2012; Trust, 2012, 2015), and to collaborate with and feel supported by education professionals (Carpenter & Krutka, 2014, 2015; Hur & Brush, 2009; Kelly & Antonio, 2016; Visser et al., 2014). Our study supports and builds on these findings. Many participants mentioned instances of acquiring knowledge, receiving emotional support, and collaborating with others through their PLNs. Participant responses also suggested that PLNs supported diverse affective, social, cognitive, and identity aspects of growth for whole teachers. As Noddings (2010) said of students, we believe teachers are not “mere collections of attributes, some to be addressed in one place and others to be addressed elsewhere” (p. 5). The flexibility and adaptivity of PLNs allowed our participants to learn, develop, and conceptualize their practice and their holistic identities as practitioners in multiple ways. As a result, many of our participants reported becoming proactive, social, and empowered professionals who continually engaged in the process of learning.

Even though PLNs might offer learning experiences that are similar in ways to that available via other avenues, PLNs cast a far wider net for potential experiences that can meet the diverse needs of whole teachers. Various teachers in our study

indicated that PLNs afforded access to additional resources and ideas, collaboration with new and diverse colleagues, re-consideration of the very meaning of their work and identities, and even the support needed to stay in the profession. While teachers, administrators, and researchers still have much to learn about PLNs, our study indicates the benefits for at least some educators are exceptional.

However, it is worth considering to what degree educators' PLNs meet the specialized needs of their work. For example, [Krutka & Carpenter \(2016\)](#) argued that social studies educators did not show evidence of using the Twitter for specific social studies purposes (e.g., civic) and [Cho \(2016\)](#) questioned whether administrators' Twitter interactions supported their core work as principals. Educators and researchers should consider whether PLN experiences tend to privilege the needs educators want met (e.g., professional support) while having less influence on the aspects of schooling that can be most important for students. Furthermore, educators must also be mindful that external motives concerning profit ([Friesen & Lowe, 2012](#); [Kelly & Antonio, 2016](#)), the agendas of organizations sponsoring professional digital spaces ([Robson, 2016](#)), or PD standardization do not interfere with PLN spaces that participants reported as positive, collaborative, and organic.

Concerning the effects of teachers' PLN activities on students, a number of our participants also described how they believed their PLNs contributed to students' learning. Even though the survey prompted the participants to describe specific changes in student learning outcomes, more than half indicated a shift in their students' mindsets and attitudes. These changes seemed to mirror those that teachers articulated concerning their own growth; many participants expressed that they believed their students were learning to become learners in the same way that they were learning to become education professionals. However, that almost one-fifth of our respondents were unable to clearly articulate how their PLN activities influenced students' learning, and in some cases simply described their own actions, means that teachers might benefit from further reflection on or evaluation of their professional learning. While serendipitous learning experiences might be a benefit of more informal PLN spaces ([Kop, 2012](#)), the requirements of schools (e.g., standards, pre-determined curriculum, testing) often necessitate intentionality towards more specific learning aims for students. PLNs can and should encourage spontaneity and creativity in education, but teachers should more clearly be able to articulate the specific learning benefits of PLNs if such learning is to be viewed as worthwhile by fellow educators and decision-makers.

Recent research suggested a positive impact on students' achievement when teachers at the same school collaborate ([Ronfeldt, Farmer, McQueen, Grissom, & t, 2015](#)), but the effects on achievement when teachers work together with educators from different schools are less well known. Such collaboration could potentially lead to rich cross pollination of ideas and the import and export of practices from different schools and districts (e.g., [Forte et al., 2012](#)), which our interpretation of the data suggested might shape students' learning in various ways. However, prior research has suggested that teacher collaboration often does not result in deeper levels of learning such as co-construction of curriculum ([OECD, 2014](#)), and this tendency has been observed in some online spaces as well (e.g., [Kelly & Antonio, 2016](#)). Although there were certainly examples in our data of more profound forms of collaboration, the depth and quality of PLN collaborations remains unclear.

Finally, while one of the strengths of PLNs is their flexibility and capacity to respond to teachers' disparate needs, the fact that the PLN term is used to describe a fairly broad phenomena means that researchers must be careful when trying to make generalizations regarding the benefits of PLNs. We are reminded of [Kennedy \(2016\)](#) wondering of PD generally, "why something so various is uniformly assumed to be a good thing?" (p. 1). While many of our respondents described what appeared to be real professional benefits from their PLNs, it is likely that some educators may be associating the term "PLN" with activities that actually have fairly limited impact or value.

7. Limitations

This research is limited by non-random sampling. Respondents may not represent trends in behavior amongst the larger population of educators, and those who responded to the survey could have been educators who are most enthusiastic about PLNs. Our participants may also have been among the more motivated educators who, in the absence of digital PLNs, would have sought out other ways to improve their practice. It is almost certain that some educators have tried to establish PLNs and found them less beneficial, and these educators' perspectives would be helpful to understanding challenges associated with PLN activities. These "hard-to-capture 'anti' voices" ([Owen, Fox, & Bird, 2015](#), p. 2) may be unlikely to visit the online spaces where we solicited participants. Our approach to data analysis may have also meant that early respondents to the survey could have had more of an influence on the coding structure used to make sense of the data.

Our participants had very diverse conceptualizations of PLNs. A small subset of participants described PLNs in ways that contrasted with our holistic definition of a PLN that spans multiple networks, communities, people, and spaces. For example, a few participants described their PLNs as professional learning communities (PLCs), while others reported that their PLNs were multiple, isolated platforms and spaces. Therefore, we faced the challenge of interpreting participants' responses which varied in the usage of the term *PLN*.

Moreover, although our survey garnered responses from participants in 47 countries, the overwhelming majority of respondents were from wealthier, Western, English-speaking countries. Differences in school systems and local cultures likely impact teachers' PLNs. For example, educators in Japan who benefit from a rich tradition of formalized, teacher-driven professional collaboration via the Lesson Study process might either utilize such a pre-existing collaboration structure to bring even greater depth to their PLN activities, or they might conversely feel less need to seek out the apparent benefits of PLNs. Educators in less wealthy countries could have limited access to the technologies that help make PLNs convenient – and thus attractive – for teachers in wealthier settings. In some cases teachers who lack English fluency might lack access in their

own language to the critical mass of people and resources that are clearly available online to English-speaking educators. In other cases, multilingual educators might derive greater benefit from being able to create even richer PLNs that combine resources and people from more diverse environments. Given the nature of our sample, such differences in school systems and local cultures that could impact teachers' PLNs may be missing from the data.

This research is also limited by its reliance upon a self report survey. In particular, we recognize the limitation associated with asking teachers to report *their* perceptions of how student learning was influenced. We acknowledge both that self-reports about teaching tend to be optimistic, but also that teachers' beliefs about the effects of PLNs may differ from students' experiences and beliefs. However, because there has been almost no research completed on the connection between PLN experiences and students' learning, we still believe our findings on teachers' perspectives offer a valuable contribution to the field and potential point of departure for further research.

Furthermore, although our non-random sample of educators prevents us from generalizing, the substantial sample size provides valuable insights from a large number of teachers. The respondents' descriptions of their PLNs and their impact are informative and provocative. They can assist policymakers and practitioners in understanding the needs of educators and assessing various approaches to support and facilitate professional learning. While self-reports are inherently limited in some regards, they can also provide useful data regarding teachers' motivations for participating in professional development. Participants' motivations have been identified as an important moderating factor on the outcomes of professional learning experiences (Kennedy, 2016; Kynt et al., 2016). We present our results so that fellow educators and researchers might further interpret the findings in light of their experiences, contexts, and research.

8. Implications for practice and research

Our study highlights that teachers can cultivate their PLNs in a variety of ways to support their disparate interests, needs, and aims for professional growth. Unlike PD days, one-size-fits-all workshops, or yearly conferences, teacher learning through PLNs can happen anytime and anywhere, and it can occur with hundreds or thousands of far-flung educators. While teaching and learning are often conceived of as social processes, isolation and individualism within educational systems can restrict social activity and learning. Adapting to and evolving with dynamic and shifting educational landscapes poses challenges that can be overwhelming for teachers and contribute to burnout (Grayson & Alvarez, 2008). PLNs might offer teachers emotional support as they seek to grow as professionals in their practice and attitudes for teaching and learning. The flexibility of PLNs allows teachers to adapt their learning experiences based on the contexts in which they work, and also offers opportunities for engagement, participation, and even community that extend beyond the walls of schools.

Considering the aforementioned benefits of PLN activities, teachers, administrators, and researchers should explore the potential of PLNs in shaping teaching and learning. Our recommendation aligns with Macià and García's (2016) suggestion that further studies are needed to examine, "how these networks influence the depth of teachers' learning and reflection" (p. 305). Teachers should aim to improve their PLN experiences through continual reflection and evaluation. Such a process might prompt teachers to, for example, recognize a weakness in their own processes and address shortcomings. Reflection has long been deemed integral to teachers' professional growth (Schön, 1983) and this is particularly true given the ever-changing educational terrain (Nagle, 2008). The colleagues and digital tools that make up PLNs can offer teachers means for support for affective, social, cognitive, and identity growth that meet the holistic needs of teachers. We agree with authors of previous studies about PLNs and online networks who have suggested that comparative and longitudinal studies that examine changes in teaching behavior, which occur concurrently with engagement in PLN activities, could offer important insights (Macià & García, 2016; Visser et al., 2014).

Researchers should also further explore the relationship between teachers' PLN activities and students' learning. A number of teachers in our study reported that their uses of new teaching strategies, resources, digital tools, and activities from their PLNs positively influenced students' learning. A few participants also believed that modeling how to learn with a PLN encouraged students to change the way they learned. However, educators should generally avoid taking a simple cause-and-effect approach when examining the impact of teacher learning on students' learning within such complex learning systems (Opfer & Pedder, 2011). Some participants found it hard to make a direct connection between what they learned from their PLNs and learning by students, but this does not necessarily mean that worthwhile changes did not occur. Since establishing whether teacher participation in PLNs may have an impact on students' learning can be difficult, we recommend approaching PLNs as complex systems that meet the diverse needs of whole teachers. By taking such a view, researchers and educators might be able to better recognize the different benefits or even shortcomings that come from PLN uses.

Like other researchers who have explored teacher learning in PLNs and online networks (Macià & García, 2016; Visser et al., 2014), we recommend that P-12 administrators and other decision-makers (e.g., superintendents, lawmakers) encourage teachers to build PLNs as a way of developing their craft. Administrators could do this by drawing on digital leaders within their schools, engaging in PLN activities themselves, cultivating local networks for educators, and supporting or potentially incentivizing PLN participation. For example, teachers in the Burlington School District in Massachusetts can earn professional development points and inservice credits for attending district-sponsored informal and formal sessions (e.g., How to Use Twitter) that support the growth of their PLNs (Larkin, 2013). Because many districts offer limited types of PD for continuing education credit, policy makers may want to consider creating more inclusive definitions of professional learning that encompass participant-driven, voluntary professional activities. Some school systems provide guidance to teachers on how they can document their PLN activities to earn required re-certification points that are part of teacher licensure systems

(see the Albemarle County Public Schools (2016) “Do It Yourself PD” web resources). Such efforts make sense given that many educators indicate a lack of incentives as a barrier to their participation in professional development (OECD, 2014).

However, it is likely that tensions will also emerge as teachers seek to receive credit for informal learning from top-down, bureaucratic structures such as licensure regimes and professional development regulations. Leaders who seek to encourage or recognize teacher self-directed learning must be careful not to unintentionally taint the personalized and organic nature of PLNs. Administrators who require participation in digital networks should be careful not to distort the nature of online environments in miseducative ways that inhibit future learning opportunities. Similarly, teachers should probably not expect to earn district credit for all PLN activities; teachers should work with administrators to determine which aspects of PLN learning could best be integrated into larger PD systems.

We hope researchers can build upon this study to address gaps that remain in the literature. Our findings suggest that PLNs are complex systems of people, digital tools, and resources. Approaching teachers' PLNs as complex and multifaceted systems (e.g., Davis & Sumara, 2006; Morrison, 2006; Opfer & Pedder, 2011) can help educators avoid simplistic process-product research paradigms that are inadequate for the phenomenon (Cochran-Smith & Lytle, 1991). Future studies are also needed to explore how teachers learn to cultivate their PLNs, how they navigate the interactions among the various components in their PLNs, and how teachers' online and off-line professional activities interact, relate, and shape learning. Additionally, because our study focused on teachers' perceptions of how PLN experiences shaped their practices and student learning, further research is needed to explore whether these changes in teaching and learning were sustained and ongoing or whether they were only one-time, short-term changes. Comparative international research could potentially shed light upon opportunities and challenges associated with PLNs that our research did not illuminate. In the past, teachers have had only very limited opportunities to interact with colleagues from other regions and cultures, and research on what happens in and results from such collaborations could be of great value to the education field.

In some cases, the technologies that are commonly utilized to build PLNs have actually been shown to expose users to a wider set of perspectives (Kop, 2012; Messing & Westwood, 2012; Morris & Morris, 2013), and although our survey did not directly address this issue, a small number of our respondents ($n = 11$) mentioned being exposed to diverse points-of-view. However, given existing critiques of new technologies as functioning as “filter bubbles” (Pariser, 2011) that limit users' interaction with diverse perspectives, future research could explore to what extent PLNs do or do not function in this manner. Moreover, while some of our respondents mentioned connecting to and with people from different nations and cultures who could offer unique perspectives, they did not delve into the quantity (e.g., number of nations or cultures) and the quality (e.g., depth of intercultural learning) of their interactions. Further research should explore whether PLNs can enhance the cosmopolitan growth of teachers and their students (Banks, 2004).

This study also raises a number of questions such as: how can schools and researchers evaluate and support uses of PLNs for the growth of teachers and students? How does such self-directed learning activity relate to the culture and goals of the schools and districts within which educators work? And, given the potentially ephemeral nature of online connections, will participants withdraw when their beliefs are challenged or when collaboration becomes difficult, rather than persisting through and overcoming such barriers? Researchers and educators should continue to investigate such questions if PLNs are to mediate professional growth that is effective and sustainable. For example, while drawing a direct line between teacher learning and student learning is challenging (Guskey, 2000), educators and researchers should aim to identify factors and practices that strengthen the relationship between the two. For the future of the development of teachers, educators and researchers should explore how teachers' PLN activities can and cannot be supported, improved, and extended.

9. Conclusion

We live in an era of rapid technological and educational change, and adapting and responding to this shifting landscape requires new knowledge, skills, and dispositions. Such variability means that the work of teachers is in flux, and the process of learning to teach should be flexible and adaptive to support this process. Educators' responses to such conditions must be multifaceted and persistent. Of course, PLNs offer no panacea or easy fix to the many educational challenges of our time. Despite largely positive responses from P-12 teachers, we identified voids and shortcomings in our data, which led us to ask numerous questions for educators, researchers, and ourselves.

However, the results from this study also offer a rejoinder for teachers who seek to meet their diverse, interconnected, and holistic needs. Participants enthusiastically described their PLNs as diverse and multifaceted networks of people, communities, tools, platforms, resources and sites. Moreover, our respondents conveyed affective, social, cognitive, and identity benefits of PLN experiences. While traditional teacher PD is often organized to meet specific needs or aims (Kennedy, 2016), which can be valuable, a strength of PLNs is that teachers are able to consider and meet the contextual demands for their situation. PLNs not only seemed to help participants meet specific pedagogic or emotional needs, but their networks also allowed many educators to forge, and move towards, new conceptions of their professional identities. Despite some vague and teacher-centered answers, many other teachers were able to extend the benefits from and in PLNs to their students in numerous ways. By teachers' accounts, PLN activities helped engage them in a continuous process of teacher growth that we believe can be a boon to a field not often accorded professional dignity (Apple, 2009; Goldstein, 2014).

PLN activities seemed to offer many teachers in our sample professional refuge. Teachers spoke enthusiastically of their PLN experiences as causing them to be “consistently positive every day now,” “excited about teaching again,” and “more relevant, more energized, more engaged than I've been in 10 years.” They also extolled the benefits of their PLN experiences,

saying, for example, that PLNs brought “dignity in the profession” through “the beauty of empowerment” in the “reciprocal neighborhood of learning” where teachers “are so much stronger as a woven rope pulling together, working together, rather than one single thread...” If it is true as our Canadian teacher contended that “together we are better,” then it seems worth the time and energy of those in education to continue to explore the potential of PLNs to meet teachers’ diverse and holistic needs.

Appendix 1

Survey instrument

Demographics

1. What is your current age?
2. What is your gender?
3. In which country do you reside?
4. What is your current profession?
5. How many years have you worked as a teacher?
6. What subject(s) do you teach?
7. What type of school do you work at (elementary, middle, high school, other)?
8. Please provide a detailed description of your PLN.
 - a. Who’s in your PLN?
 - b. Which tool(s) do you find most valuable for finding professional knowledge?
 - c. What specific blogs, sites, hashtags, and e-newsletters do you follow?
 - d. Are you a member of an online groups or communities?
9. How often do you use the following tools as part of your PLN (daily, weekly, monthly, less than once a month, never)?
 - a. Facebook
 - b. Twitter
 - c. Edmodo
 - d. Blogs
 - e. Social bookmarking
 - f. Google+
 - g. LinkedIn
 - h. Pinterest
 - i. Online courses/MOOCs
 - j. YouTube
 - k. Other: _____
10. Describe the 2–3 most important things you have learned from your PLN and list where learned them from. Please be as detailed as possible.
11. Have you made changes to your teaching as a result of the information that you learned from your PLN? (Yes/No)
12. (If “Yes” is selected) Describe how your teaching has changed. Please be as detailed as possible.
13. How have these changes shaped your students’ learning? Please respond in terms of learning outcomes (e.g., Have your students shown changes in learning after you made changes to your teaching practice? If so, how do you know?).

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