

Impact of Professional Development for Science Teachers on Efficacy and Autonomy

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There has been significant media attention granted to teacher shortages in the past few decades, especially in the field of science teaching. These shortages have been linked to decreased student learning and performance. A significant cause of these shortages is high teacher turnover. The converse of turnover, retention, has been linked to professional development opportunities both directly and indirectly. Professional development may have the capacity to impact retention indirectly by supporting teachers' beliefs of self-efficacy and collective efficacy, as well as their perceptions of professional autonomy, all factors that have been separately linked to teacher retention. This study investigates the professional development opportunities available to teachers in a suburban science department, and how those teachers believe the programs impact their efficacy and autonomy.

The study was conducted within the secondary science department in a large suburban school district. Four teachers and two administrators were interviewed in group and individual settings. Qualitative analysis of interview transcripts explored the relationship between professional development opportunities available to teachers within this department, and teachers' beliefs of efficacy and perceptions of autonomy.

Findings indicated that teachers had access to professional development programs that improved their beliefs of efficacy and perceptions of autonomy. Data suggested ways in which the programs did so, as well as how these teachers and administrators felt the programs could support efficacy and autonomy more. The data also showed that teacher reflection and collaboration can

support their beliefs of efficacy. The findings are consistent with the literature relating to these themes and provide additional insight into the impacts of the professional development opportunities available within the department studied.

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1.0 Introduction

In the past few decades, high-profile national reports have drawn attention to teacher shortages across the United States, especially in the field of science (Beebe, 2013; Ingersoll & Perda, 2010). Research and professional science teaching organizations have tied these shortages to low student achievement, low United States educational performance compared to that of other countries, the minority achievement gap (Podolsky, Kini, Bishop, & Darling-Hammond, 2016; Wronowski, 2018), and “even to the security of the nation” (Ingersoll & Perda, 2010, p. 564). Scholars have been exploring the degree, causes, and impacts of these shortages, as well as factors that may ameliorate the problem (Ingersoll & Perda, 2010).

However, the cause of these shortages is not a lack of new teachers entering the profession (Ingersoll & Perda, 2010; Ingersoll & Strong, 2011). Surveys completed by the United States Department of Education indicate that the supply of new teachers across the country has been enough to fill vacancies due to retirement and increased student population, even within subjects that have more hiring difficulties, such as science, math, special education, and foreign languages (Ingersoll & Perda, 2010). The cause of the shortages, these authors suggest, is likely high teacher turnover (Ingersoll & Perda, 2010; Ingersoll & Strong, 2011). Additionally, the degree of teacher shortages is localized and varies considerably between schools, often varying significantly between schools within the same district or region (Ingersoll & Perda, 2010).

Teacher turnover has a negative impact on student learning (Podolsky et al., 2016), especially in urban schools (Wronowski, 2018). The variation in turnover results in more inexperienced and underprepared teachers in high-poverty and high-minority schools, exacerbating the gap in learning for students in these schools (Podolsky et al., 2016). To make

matters worse, teachers who improve student achievement the most are the most likely to leave within five years (Wronowski, 2018). Turnover also has a direct financial cost to a district which eventually impacts taxpayers (Podolsky et al., 2016). If turnover is the problem, retention is the goal (Ingersoll, Merrill, & May, 2012).

In the literature, teacher retention has been linked directly to professional development opportunities (Ingersoll & May, 2012; Wronowski, 2018). Teachers across content areas have mentioned that relevant content-specific professional development contributes to higher job satisfaction, and therefore higher retention (Ingersoll & May, 2012; Wronowski, 2018) both for new teachers (Callahan, 2016; Podolsky et al., 2016) and experienced teachers (Beebe, 2013; Moscovici, 2009). Moreover, science teachers are less likely than teachers in other subject areas to receive comprehensive pre-service training that has been correlated with higher retention (Ingersoll, 2012).

There is also evidence of professional development indirectly affecting teacher retention. Recent research is showing correlation between professional development and beliefs of efficacy (Beebe, 2013; Deehan, 2017; Knowles, 2017), as well as efficacy and retention (Beebe, 2013; Bolger & Somech, 2004; Cullis, 2009; Lee, Zhang, & Yin, 2011). Self-efficacy is the belief in one's capabilities across multiple situations and environments (Bandura, 2012) and collective efficacy is the application of self-efficacy to a group or organization (Beebe, 2013). Quality professional development has the capacity to improve teachers' beliefs of self-efficacy and collective efficacy, and thus impact teachers' decision to remain in a position (Bogler & Somech, 2004; Hopkins, 2018; Knowles, 2017).

In addition to beliefs of efficacy, teachers often cite professional autonomy as an important factor in deciding to stay in a position (Ingersoll & May, 2012). Professional autonomy is teachers'

perceptions of the “degree of individual teacher control in their classrooms” over factors such as curriculum, student management and evaluation, and pedagogical techniques (Ingersoll & May, 2012, p.442). Professional development has the capacity to support teachers’ professional autonomy (Kennedy, 2005; Pearson & Moomaw, 2005). As a result of improved beliefs of efficacy and perceptions of professional autonomy, teachers may be more likely to stay in their current positions (Beebe, 2013; Cullis, 2009; Lee et al., 2011).

1.1 Problem of Practice

The research I have read on professional development, efficacy, and autonomy draws a link between both pre-service and in-service professional development and beliefs of efficacy and perceptions of autonomy (Beebe, 2013; Callahan, 2016; Deehan, 2017; Ingersoll & May, 2012; Ingersoll, Merrill, & May, 2012; Ingersoll & Strong, 2012; Pearson & Moomaw, 2005; Podolski et al., 2016; Wronowski, 2018), especially when the professional development programs are relevant and high-quality, as well as when programs incorporate teachers’ previous knowledge and input into planning the program. This is important given the correlation between retention, beliefs of efficacy, and perceptions of autonomy, as well as the prevalence of hiring difficulties for science teachers (Beebe, 2013; Ingersoll & Perda, 2010).

The research describes characteristics of professional development programs that can have a positive impact on efficacy beliefs and professional autonomy, but these programs may not be provided in all schools (Hodges, Tippins, & Oliver, 2013). Science teachers may not be aware of the professional development opportunities available to them, or why some programs may be more

helpful than others. Thus, there is need for further research into actual professional development opportunities accessible to local science teachers and teachers' perceptions of them.

1.2 Inquiry Questions

Primary Question: Do science teachers have opportunities to engage in PD that supports the development of self-efficacy, collective efficacy, and sense of professional autonomy?

- a. What professional development do science teachers think is available to them?
- b. What do school leaders think is available to teachers?
- c. How do teachers and school leaders think these opportunities impact teachers' self- and collective efficacy?
- d. How do teachers and school leaders think these opportunities impact teachers' perceptions of professional autonomy?
- e. What other factors do teachers and school leaders think support efficacy and professional autonomy?

2.0 Review of the Literature

I am interested in the connection between professional development, beliefs of efficacy and perceptions of professional autonomy, and science teacher retention. While I have attempted to be as thorough as possible in investigating the correlation between professional development, efficacy, professional autonomy, and science teacher retention, there is a significant body of literature on these topics. I have primarily used the following search terms: STEM teacher turnover, teacher retention, science professional development teacher retention, science teacher retention, professional learning teacher retention, science pd self efficacy, professional development teacher self-efficacy, professional development collective efficacy, professional development teacher autonomy. When looking at sources that did not focus on science, I would search the reference list for any citations that mentioned science. I focused my search to publications from the last ten years, unless there was limited information on a topic or an older article that had been frequently cited by others.

2.1 Introduction

I have created a simplified model to explain my reasoning for the correlation between professional development and teacher retention. I have focused on science teachers because of the hiring difficulties described previously. Figure 1 describes my reasoning, beginning with science teachers having opportunities for professional development due to gaps in knowledge that are common in science teachers. Science teachers are less likely to have pedagogical training, they are

not always given opportunities to develop content knowledge or pedagogical knowledge, their professional development often does not consider previous knowledge, and they do not have sufficient time to collaborate with other colleagues or content experts (Ingersoll, 2012; Ingersoll & May, 2012; Wronowski, 2018). Due to these gaps, science teachers have opportunities for professional development, which can create greater beliefs of self-efficacy, collective efficacy, and professional autonomy. These beliefs can lead to higher retention of science teachers.

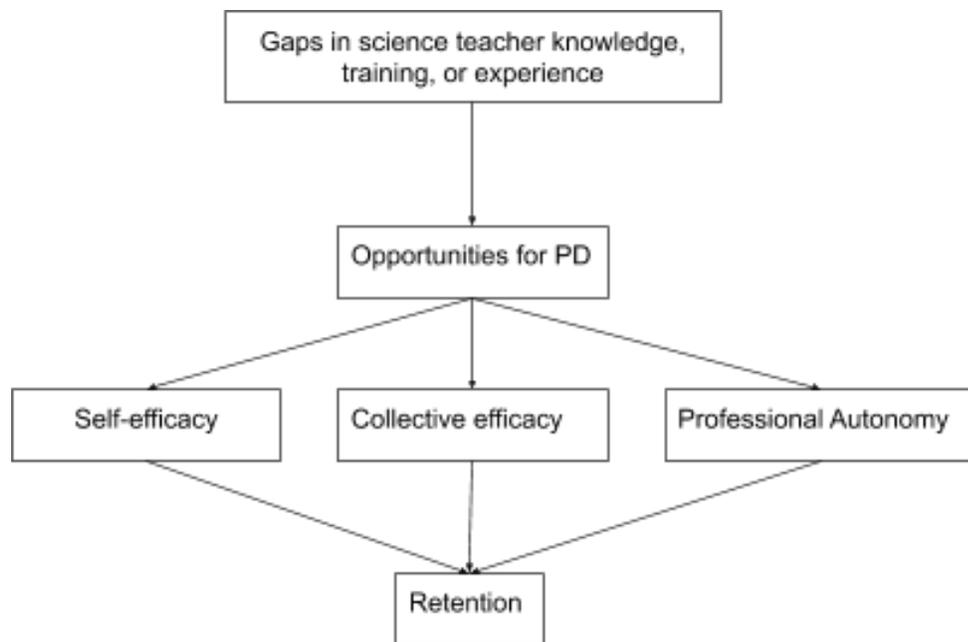


Figure 1. Professional Development and Job Retention Model

In this review, I will explore current research and literature relating to professional development, beliefs of efficacy, perceptions of professional autonomy, and science teacher retention with the goal of answering the following questions to provide a rationale for my inquiry:

- How can professional development impact science teacher retention?

- How can professional development impact beliefs of efficacy and perceptions of professional autonomy?
- How can beliefs of efficacy and perceptions of professional autonomy impact science teacher retention?

2.2 Teacher Turnover and Retention

2.2.1 Causes of Teacher Turnover

Teacher turnover is a primary factor in the shortage of teachers. Every few years, the National Center for Education Statistics (NCES), which is part of the United States Department of Education, distributes surveys to about 50,000 teachers, as well as administrators and districts, in all types of schools and districts in all 50 states (Ingersoll & Perda, 2010). As a result of their research using these surveys, Ingersoll and Perda (2010) found that teacher turnover is causing the hiring difficulties, rather than a shortage of new teachers. They argue that although current policy aimed at improving math and science teacher shortages focuses on recruitment of new teachers, it may be more worthwhile to focus on reducing turnover, since the supply of new teachers is sufficient to fill positions vacated due to non-retirement turnover. Podolsky et al. (2016) and Moscovici (2012) also agreed that it is important to address teacher turnover as a strategy for reducing the teacher shortage.

Ingersoll and Perda (2010) distinguish between teacher attrition, which is when teachers leave the teaching profession entirely, and teacher migration, which is the movement between different schools. Both create challenges in schools, but attrition results in fewer available teachers

across the profession (Ingersoll & Perda, 2010). Teaching has a higher attrition rate than many professions, especially in the first years (Ingersoll & Strong, 2011).

Challenging working conditions and job dissatisfaction are significant factors in teacher turnover (Ingersoll & Perda, 2010; Podolsky et al., 2016). More than 20% of teachers surveyed found the following factors “extremely” or “very important” in their decision to leave: teachers were likely to leave if they were “dissatisfied with school assessment/accountability procedures,” “dissatisfied with administration,” and “dissatisfied with teaching as a career” (Podolsky et al., 2016). Teachers are also more likely to leave schools with lower salaries (Podolsky et al., 2016).

Callahan (2016) found, in her review of the literature, that attrition of beginning teachers was correlated with a lack of or low quality mentoring program. New teachers leave the profession for reasons that include being unable to contribute to school culture, feeling unable to positively affect student achievement, and having classroom management issues. Mentoring programs can help with these challenges (Callahan, 2016). Podolsky et al. (2016) found that previous research supported the importance of induction for new teachers. They also found that support for new teachers was a significant factor in teacher turnover, as was adequate preparation to enter the classroom. Ingersoll and Strong (2011) saw evidence in the literature that a comprehensive induction program for beginning teachers helped create an environment where teachers could “learn the craft and survive and succeed as teachers” (p. 203).

Kokka (2016) suggests more research into the reasons for retention, rather than focusing on attrition and turnover as in much of the literature. Kokka interviewed experienced STEM teachers at one school site with a racially diverse population of economically disadvantaged students, with a history of high retention of STEM teachers. She found that significant factors for

retention included administrative support for behavioral issues, instructional autonomy, and social emotional rewards from student interactions (Kokka, 2016).

Ingersoll, Merrill, and May (2012), who also looked at NCES survey data, found that college, degree, or preparation route did not have an impact on turnover. New teachers with education degrees were no more or less likely to leave after one year than new teachers with other degrees. However, despite the type of degree, the amount of practice teaching and learning theory were correlated with retention. Additionally, the amount of observation of other teachers and feedback received by first-year teachers was also important for retention (Ingersoll et al., 2012).

2.2.2 Effects of Teacher Turnover

Staffing problems have been tied to lower student achievement, inequitable educational outcomes between demographic groups, and low United States educational performance in the international community. As a result of these staffing problems, schools may need to “lower standards to fill teaching openings, in turn inevitably leading to high levels of underqualified mathematics and science teachers and lower student performance” (Ingersoll & Perda, 2010, p.564). Beginning teachers take up to seven years to be considered highly qualified, but at least one-third of teachers leave the profession within five years (Callahan, 2016). It is these experienced teachers that are most likely to produce higher levels of student achievement (Callahan, 2016).

In addition to effects on students, there is also a direct financial cost of teacher turnover. The cost to replace a teacher in the United States is \$8000 on average (Callahan, 2016), and can be as \$20,000 per teacher in large, urban districts (Podolsky et al., 2016). In 2012, the \$2.2 billion was spent recruiting, hiring, and training new teachers.

The effects of teacher turnover are more significant in schools that serve low-income students and students of color. In 2012-2013, the rate of attrition in high-poverty schools was one in ten, whereas fewer than one in fifteen teachers in low-poverty schools left the profession (Podolsky et al., 2016). This may be due to the presence of worse working conditions, which are more commonly found in low-income schools (Podolsky et al., 2016). Additionally, the presence of shortages of new teachers entering the profession varied more significantly between schools in the same district than between regions or states, indicating possible supply shortages locally (Ingersoll & Perda, 2010). Retaining experienced and effective teachers can help not only with the financial burden of teacher turnover, but also allow schools and districts to focus on reform and transformation strategies to improve student achievement (Callahan 2016).

2.2.3 Science Teacher Turnover

The NCES surveys revealed that between 1987 and 2008, the number of teaching vacancies was consistent across subjects, but there were more hiring difficulties in math, science, special education, and foreign language (Ingersoll & Perda, 2010). On the other hand, there were more than enough new math and science teachers to keep pace with increases in student number and teacher retirement, although not as many as in other subjects (Ingersoll & Perda, 2010). Ingersoll and Perda (2010) argue that policy aimed at reducing hiring difficulties for science teachers should focus on reducing turnover, rather than on recruitment.

The surveys revealed that math and science teachers were also more likely to leave after one year than new teachers in other subjects (Ingersoll et al., 2012). Additionally, new math and science teachers were more likely than new teachers in other subjects to hold degrees in areas other than education and were more likely to have attended an alternative certification program. In

particular, science teachers were less likely to have learned teaching methods and done practice teaching before entering the classroom (Ingersoll et al., 2012), both of which have been correlated with higher retention.

However, Ingersoll and May (2012) found that math and science teachers were no more likely than other subject teachers to leave for jobs in other sectors. They were, on the other hand, more likely to get non-teaching jobs in education, especially science teachers (Ingersoll and May, 2012).

Although there isn't higher turnover in math and science compared to other subjects, the turnover is localized and varies considerably between schools (Ingersoll & Perda, 2010). Studying the causes of turnover is particularly important for teachers of color, math and science teachers, and urban public school teachers, because of their significant impact on students (Kokka, 2016).

Moscovici (2009) collected data specifically from new secondary science teachers. She suggests that they tend to do better in schools where "there is a perceived cohesive vision regarding science education" and where all stakeholders are all working towards a common goal. Otherwise, there is no cohesion and stakeholders blame each other for results. She suggests a systems approach method to overcoming current challenges in science education. She also suggests collaboration between pre-service training programs and local schools, to build cohesiveness in training and a focus on issues these teachers will likely face.

Cullis (2009) discusses the importance of self-efficacy for science teacher retention. She also found that personal characteristics varied with the importance of certain reasons for staying in a position. For example, a teacher's preparation, age, or self-efficacy correlated differently with the importance of compensation, advancement, and belonging.

Ingersoll and May (2012) found that other factors correlated with science teacher turnover were student discipline problems in the school and receiving “useful content-focused PD,” rather than student -discipline focused PD. Also, these factors “increased cumulatively” the likelihood of turnover (Ingersoll & May, 2012). Salary was also an important factor in science teacher turnover (Ingersoll & May, 2012).

Hodges et al. (2013) found one school in the rural south with 100% retention of science teachers during the study period as well as relatively high graduation rates. They found themes of deprofessionalization of teaching, such as as teachers not allowed to provide input into schoolwide decision-making processes or evaluation based on standardized tests rather than instruction or professional development. They suggested instead a policy of shared accountability, where science teachers partner with administrators and policymakers to make decisions on outcomes. The interviewed teachers shared that they had valued professional learning experiences that expanded their content knowledge and integrates current science research with science teaching. Hodges et al. (2013) suggest science teachers can be better retained by “restructuring the professional learning environment in such a way that appeals to the highly qualified teachers we hope to retain.” They summarize by stating that the deprofessionalization of teaching has a negative impact on job satisfaction and retention for science teachers.

It is important that highly qualified science teachers are recruited and retained because of the “pivotal role” they play in the learning environment (Hodges et al., 2013).

2.3 Beliefs of Efficacy

2.3.1 Theoretical Framework

Self-efficacy theory fits into the greater framework of social cognitive theory, which is described as the relationship between self, behavior, and the environment, as well as how behavior can have an impact on these other factors (Bandura, 2012). Self-efficacy is the belief in one's capabilities across multiple situations and environments. There are four ways to develop self-efficacy: mastery experiences are created by experiencing easy successes or showing resilience by learning from failure rather than being demoralized by it; social modeling is learning from the success of people who one perceives as similar; social persuasion is when one is persuaded to believe in oneself by another; and lastly, people develop self-efficacy through their own emotional states, such as increasing fitness or reducing depression (Bandura, 2012). "Self-efficacy beliefs affect the quality of human functioning through cognitive, motivational, affective, and decisional processes" (Bandura, 2012, p. 13). In other words, self-efficacy is part of a person's success in many areas of life, including career. Self-efficacy describes whether someone will think in self-enabling or self-debilitating ways (Bandura, 2012).

Bogler and Somech (2004) defined self-efficacy as "one's perception of one's competence and ability to act" and described its connection to effectiveness, organizational commitment, and desire to stay in the teaching profession.

In consideration of several decades of his research on self-efficacy, Bandura (2012) argues that self-efficacy beliefs can have a positive impact on behavior because a person will respond to setbacks or set goals differently depending on their self-efficacy beliefs. However, he also

discusses the challenges in measuring self-efficacy, and recommends the consideration of many types or areas of self-efficacy, rather than one trait that an individual has or doesn't have.

2.3.2 Efficacy and Teacher Retention

While I was unable to find explicit evidence connecting efficacy to teacher retention, there is a logical connection that scholars are starting to explore. In Cullis' (2009) EdD dissertation, she proposes a theoretical framework that describes the reasons middle school science teachers stay or leave their positions. She gave surveys to teachers to evaluate job satisfaction, intent to stay, and school climate. She found a significant correlation between teachers' feelings of self-efficacy and job satisfaction. She suggested this correlation may be because teachers who feel they can produce changes in student behavior and performance can feel more satisfied (Cullis, 2009). She also found that programs that are associated with feelings of collegiality, belonging, and self-efficacy, such as training or mentoring, were associated with higher job satisfaction. Cullis (2009) suggested that school leadership should foster a school environment that supports teachers' self-efficacy in order to improve job satisfaction and lead to higher retention (Cullis, 2009).

2.3.3 Collective Efficacy

Collective efficacy is the application of self-efficacy to a group or organization (Beebe, 2013). A properly-functioning organization requires that individuals believe in the efficacy of the organization, especially if the performance of the organization depends on individual and interdependent effort (Bandura, 2012).

In Lottie Beebe’s (2013) Ed.D dissertation, she surveyed 515 teachers in one large school district, with the goal of quantifying the relationship between teachers’ professional learning, job satisfaction, collective efficacy, and retention. She asked questions “relating to job satisfaction, professional learning, collective efficacy, and the intent to stay (retention)” (Beebe, 2013, p. 96). She found correlation between collective efficacy and job satisfaction, and correlation between collective efficacy and professional development. She used her statistical results to create the theoretical model in Figure 2.

While they did not directly address retention, Bogler and Somech explored teachers’ commitment to their organization and commitment to the profession. Their study explores which subcategories of teacher empowerment relate to teachers’ organizational commitment, professional commitment, and organizational citizenship behavior. They surveyed 983 teachers in

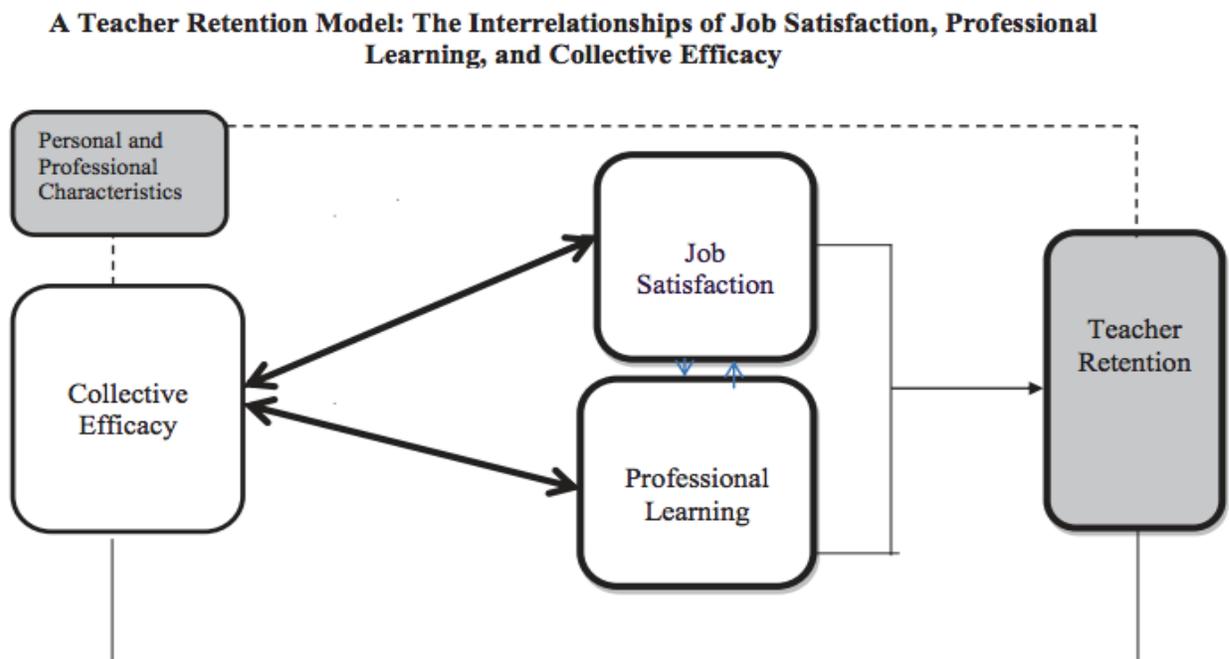


Figure 2. A Teacher Retention Model: The Interrelationships of Job Satisfaction, Professional Learning, and Collective Efficacy (Beebe, 2013, p.96)

Israeli middle and high schools and found that professional growth, status, and self-efficacy were predictors of organizational and professional commitment. Decision making, self-efficacy, and status were predictors of organizational citizenship behavior. Self-efficacy and status were predictors of the most different types of commitment, so the researchers suggest “Principals need to establish working conditions that will bring teachers to perceive themselves as having a high level of competency and experiencing high status and self-esteem” (Bogler & Somech, 2004, p. 286). Also, teachers who see themselves as professionals or see opportunities for professional growth may contribute more to the organization, as they feel more organizational commitment. Professional growth, “one’s belief that one works in a supportive and nurturing environment that stimulates professional growth and development,” may also related to organizational commitment and commitment to the teaching profession.

2.4 Professional Autonomy

2.4.1 Theoretical Framework

Although the exact definition of autonomy may differ from teacher to teacher, it can be defined as independence and the authority to make decisions in one’s own teaching practice and classroom (Bredeson, 2000; Pearson & Moomaw, 2005). Bredeson (2000) describes autonomy as the ability make decisions and have a voice in the instructional process, both as teachers and learners. Professional autonomy requires collaboration to support the growth of teachers’ practice as well as input into policy formation (Hyslop-Margison & Sears, 2000). It is related to teachers’ sense of professional responsibility and self-imposed accountability and requires that teachers to

contribute to decisions “of what constitutes appropriate and effective professional practice” (Hyslop-Margison & Sears, 2000, p. 7).

Pearson and Moomaw (2005) summarize several studies that support autonomy as an important factor in teachers’ job satisfaction. They also describe that autonomy is a key element of professionalization of teaching, so I will be using the term professional autonomy to address the close link between the two ideas.

Pearson and Moomaw (2005) described measures of two different types of autonomy: curriculum autonomy and general teaching autonomy. Curriculum autonomy is the ability to choose instructional materials, as well as making decisions surrounding planning and sequencing. General teaching autonomy is the ability of teachers to feel control over their work environment and make on-the-job decisions. Ingersoll and May (2012) measured autonomy as the “degree of individual teacher control in their classrooms over course content, textbook choice, homework, student discipline, student evaluation, and techniques” (p.442).

In order for professional autonomy to “be meaningful” at the classroom level, it must also be encouraged at higher levels, by allowing teachers to contribute to processes at the schoolwide and district-wide levels (Hyslop-Margison & Sears, 2000). Professional autonomy can also be affected by policy on a larger scale. Hyslop-Margison and Sears (2000) argue that professional autonomy has declined in the last few decades in the United States, due to legislation such as No Child Left Behind, which limits the decision-making ability of teachers.

Lastly, scholars suggest that strengthening teachers’ professional autonomy can also improve student learning in the classroom and encourage students to develop their own sense of intellectual autonomy (Hyslop-Margison & Sears, 2000).

2.4.2 Professional Autonomy and Teacher Retention

Many scholars have found a link between professional autonomy and teacher retention (Ingersoll & May, 2012; Ingersoll & Perda, 2010; Pearson & Moomaw, 2005; Wronowski, 2018). Pearson and Moomaw (2005) cite multiple studies that have shown that teachers most often leave the classroom due to a lack of professional autonomy. Wronowski (2018) found that teachers often cite respect as professionals as a factor in whether they choose to remain in their jobs. Ingersoll and May (2012) found that math teachers most commonly cited degree of professional autonomy as the reason for remaining in or leaving their jobs. Ingersoll and Perda (2010) analyzed data from large surveys and found that degree of individual classroom autonomy was one of the best predictors of teacher retention.

Additionally, the research supports the link between professional autonomy and job satisfaction, which is also an important factor in retention. Pearson and Moomaw (2005) found in their own surveys of teachers that teachers with more perceived autonomy had higher job satisfaction and lower levels of job-related stress. Specifically, teachers who perceived higher levels of curriculum autonomy also had more job satisfaction and less stress. Overall, Pearson and Moomaw (2005) suggest that teachers' perceived professional autonomy can provide insight into job satisfaction and future retention.

2.5 Professional Development

2.5.1 Professional Development and Efficacy

Self-efficacy beliefs can have positive impacts on behavior because a person will respond to setbacks or set goals differently depending on their self-efficacy beliefs (Bandura, 2012). Professional development should be designed in such a way that it supports feelings of self-efficacy (Hopkins, 2018; Knowles, 2017).

Lumpe, Vaughn, Henrikson, and Bishop (2014), in their chapter discussing the literature on professional development and teacher's beliefs of efficacy, discuss several features of professional development that have had positive impacts on student learning. They suggest that, based on past research, professional development should be sustained in duration, relevant to curriculum, combined with coaching or mentoring, and part of a supportive environment. However, they also argue that teacher's beliefs of self-efficacy and collective efficacy can be affected by professional development, which can have a positive impact on students. Lumpe et al. (2014) emphasize the importance of professional development that address teacher's beliefs of efficacy, because "such beliefs may play a role in the quality of teaching and ultimately, student learning" (p. 60).

Additionally, teachers should have a voice in the decision-making surrounding professional development (Knowles, 2017; Wronowski, 2018). Professional development takes time away from students, which teachers stated is the most important factor in their job, so teachers should have input into the professional development process (Wronowski, 2018). Since professional development addresses "all domains of teacher empowerment," teachers without a

voice in the process can feel negatively about all aspects of teacher empowerment (Wronowski, 2018).

Knowles (2017) suggests including experienced teachers in the professional development process, including instruction and mentoring, can improve both their own self-efficacy and that of the other teachers learning from them. He also stresses the importance of follow-up sessions, ongoing support, and teachers sharing the responsibility for maintaining the improvement in outcomes.

Beebe (2013) suggests that effective and relevant professional development will improve confidence, which will improve job satisfaction and retention. She found correlation between collective efficacy and job satisfaction, and correlation between collective efficacy and professional development. Deehan (2017) also argues that quality professional development, that cooperative learning, inquiry learning, problem based learning, and other student-centered practices should, has consistently been shown to improve efficacy beliefs. Deehan (2017) suggests future research in measuring efficacy beliefs across the transition from pre-service to in-service teaching, as well as looking at the durability in changes to efficacy beliefs after interventions.

2.5.2 Professional Development and Professional Autonomy

Scholars have suggested that high quality professional development can improve teachers' sense of professional autonomy (Covay Minor et al., 2015; Hyslop-Margison & Sears 2000; Wronowski, 2018). Hyslop-Margison and Sears (2000) suggest that teachers engage in professional development that allows them to engage critically with traditional classroom practice. By allowing teachers to examine and revise traditional classroom practices, rather than

transmitting knowledge from more experienced teachers to less experienced, teachers are developing a sense of professional autonomy.

Kennedy (2005) developed a theoretical framework that categorized in-service professional development in a spectrum of increasing capacity for professional autonomy. She describes nine different professional development models that fall into three categories: transmission, transitional, and transformative. Transmissional professional development has teachers trained to meet the “status quo” of their colleagues. Transformational professional development, on the other hand, “provides a supportive, but challenging forum for both intellectual and affective interrogation of practice” (Kennedy, 2005, p. 243). In other words, it allows for growth of all individuals as well as their combined practice, rather than the growth of the learners only. Transitional models have the capacity to support either transmissional or transformational professional development.

Kennedy describes the characteristics of the models of professional development which fall into each of the categories. She then suggests that the three categories support professional autonomy from transmission, to transitional, to transformative models. Transformational professional development has the greatest capacity to support professional autonomy.

Bredeson (2000) suggests ways that principals can approach professional development in a way that fosters teachers’ perceptions of professional autonomy. He suggests that teachers should have input into professional development opportunities, and that these opportunities can serve as a medium for dialogue between school leaders and teachers regarding teachers’ professional decision-making and leadership opportunities. Bredeson argues that school leaders are partners and guides that can move teachers towards greater independence and professional autonomy, rather than serving merely as gatekeepers to their learning.

2.5.3 Science Professional Development

Research suggests that high-quality pre-service and in-service professional development programs for science teachers can improve their self-efficacy beliefs (Deehan, 2017) and teacher retention (Ingersoll et al., 2012). Additionally, information in the field of science develops so quickly that in-service professional development is important to keep teachers up to date (Hopkins, 2018).

Deehan (2017) suggests that “professionally relevant, resource rich science programs could enhance the personal science teaching efficacy beliefs of in-service teachers across a multitude of contexts” (p. 45). Evidence supports the use of complex, cooperative and learner-centered practices for science teacher education. Moreover, content-heavy science courses should no longer make up the bulk of pre-service and in-service science education programs, but rather cooperative learning, inquiry learning, problem based learning, and other student-centered practices should, as they have consistently been shown to improve efficacy beliefs (Deehan, 2017).

Ingersoll et al. (2012) looked specifically at pre-service training of first year science teachers. They found that certain aspects of pre-service training had a significant impact on their retention after one year. Math and science teachers were more likely to hold non-education degrees than new teachers in other subjects and were more likely to have attended an alternative certification program. In particular, science teachers were less likely to have learned teaching methods and done practice teaching before entering the classroom. They also found that math and science teachers were also more likely to leave after one year than new teachers in other subjects (Ingersoll et al., 2012).

Other factors correlated with science teacher turnover were student discipline problems in the school and receiving “useful content-focused PD,” rather than student -discipline focused PD. Also, these factors “increased cumulatively” the likelihood of turnover (Ingersoll et al., 2012).

Covay Minor et al. (2016) looked at how professional development impacted science teachers with different levels of experience. They found that what science teachers learn and do as a result of high-quality professional development program depends on their previous knowledge. Teachers focused on what they needed the most. The researchers summarize their findings with the suggestion that science teachers’ previous knowledge impacts how they learn and change their practice as a result of professional, which supports the use of differentiated programs based on prior knowledge.

2.6 Summary

The body of literature draws a link between both pre-service and in-service professional development and teacher retention (Beebe, 2013; Callahan, 2016; Deehan, 2017; Ingersoll & May, 2012; Ingersoll et al., 2012; Ingersoll & Strong, 2012, Podolski et al., 2016; Wronowski, 2018), especially when the professional development programs are relevant and high-quality, incorporating teachers’ previous knowledge and input into planning the program. This is important given the prevalence of hiring difficulties for science teachers, especially in the highest-need schools (Beebe, 2013; Ingersoll & Perda, 2010).

Additionally, professional development can impact science teacher retention indirectly. It can have a positive impact on science teachers’ self-efficacy and collective efficacy beliefs (Beebe, 2013; Hopkins, 2018, Knowles, 2017), while efficacy beliefs can improve job satisfaction and

retention (Bolger & Somech, 2004; Cullis, 2009). Professional development can also foster teachers' perception of professional autonomy (Covay Minor et al., 2015; Hyslop-Margison & Sears 2000; Wronowski, 2018), which is correlated with higher job satisfaction and retention (Ingersoll & May, 2012; Ingersoll & Perda, 2010; Pearson & Moomaw, 2005; Wronowski, 2018).

There is, however, room for further research into actual professional development opportunities accessible to local science teachers. The research describes characteristics of professional development programs that can have a positive impact on efficacy beliefs and perceptions of professional autonomy, as well as the link between efficacy, autonomy, and retention. However, science teachers may not have access to these programs or be encouraged to participate in them. Science teachers may not be aware of the professional development opportunities available to them, or why some programs may be more helpful than others.

These gaps have conceptually informed my primary inquiry question. The sub-questions have been informed by the methodological aspect of the literature with the goal of answering the primary question as well as providing practical information for the stakeholders involved.

Primary Question: Do science teachers have opportunities to engage in PD that supports the development of self-efficacy, collective efficacy, and sense of professional autonomy?

- a. What professional development do science teachers think is available to them?
- b. What do school leaders think is available to teachers?
- c. How do teachers and school leaders think these opportunities impact teachers' self- and collective efficacy?
- d. How do teachers and school leaders think these opportunities impact teachers' perceptions of professional autonomy?

- e. What other factors do teachers and school leaders think support efficacy and professional autonomy?

3.0 Methodology

In this chapter, I describe the methods, instruments, and analyses used in this investigation. The development of the investigation was guided by the goal of addressing the inquiry questions on the previous page.

3.1 Stakeholders

The stakeholders involved in my inquiry are the teachers and administrators at the district I am investigating. The district has approximately 50 science teachers at the secondary level, with a wide range of years of experience in teaching. With the information gathered from this inquiry, the administration of the school district will have a better idea of what qualities of their professional development opportunities may be positively impacting teachers' beliefs of efficacy and perceptions of autonomy. Additionally, I hope that the results of my inquiry will be useful to administrators in other districts looking to improve efficacy and autonomy in their districts.

The students are significant stakeholders as well. The quality of learning can be impacted by teacher turnover, so attempts to reduce turnover can be beneficial to students. I am also a stakeholder in this inquiry. From my experience as a teacher, I believe there is a link between professional development, beliefs of efficacy, and perceptions of professional autonomy. After completing the inquiry, I now have a better understanding of this link.

3.2 Inquiry Design

Below, I will describe the methods and analysis that I used to answer the inquiry questions. The instruments I used for exploring the relationship between professional development opportunities available to science teachers and beliefs of efficacy have been informed by the literature on professional development, self-efficacy, collective efficacy, and professional autonomy, including the ideas of Deehan (2017) and Ogbomo (2002).

I used an interview study to investigate the science department of the secondary schools within a district that has an extremely low level of teacher turnover. As many as one in ten teachers leave the profession each year in high-poverty schools, and as few as one in fifteen in low-poverty schools (Podolsky et al., 2016). The district I studied has only 1.1% of its teachers in their first or second year of teaching, which is an extremely low level of turnover. While other factors can also impact teacher retention, I have chosen to investigate the professional development opportunities available to the science teachers within this district. I looked at the way teachers think these programs affected their beliefs of efficacy and perceptions of autonomy, as well as the impacts the administrators had intended.

I picked this design because an interview study allowed me to investigate the nuances of the professional development opportunities offered to science teachers within the setting of one school district with very low turnover, from the point of view of multiple stakeholders. I explored teachers' and administrators' beliefs on the available opportunities, what they have learned from these programs, and how they feel these programs have impacted their beliefs of efficacy and perceptions of autonomy, all with the depth of an interview study. Figure 3 is a diagram of the inquiry design.

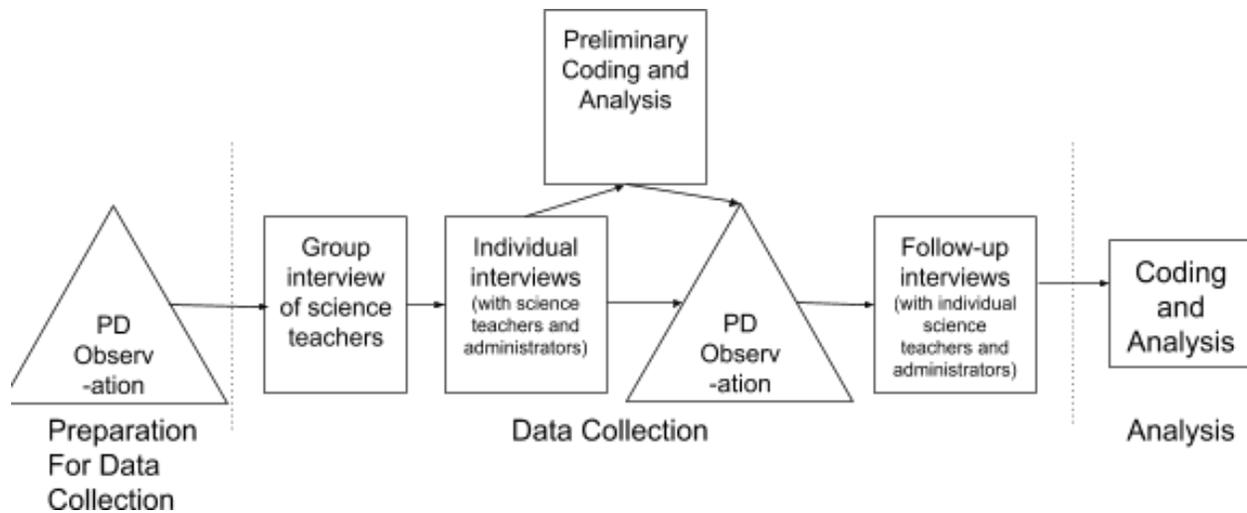


Figure 3. Diagram of all parts of inquiry design

As Figure 3 describes, I first observed a PD program. I used the initial professional development program as a topic to spark conversation about teachers' professional development experiences in general. By observing one program without collecting data, I was able to more easily engage in a common vocabulary to discuss the program and others with the teachers during the group interview. The group interview was primarily designed to acquire a general sense of how teachers view professional development and how they feel it impacts instruction in their classroom and instruction across the school. I was able to hear ideas that I could use in the individual interviews, in which I probed for more information on teachers' beliefs of self-efficacy, collective efficacy, and professional autonomy, all within the context of professional development. Following the first round of individual interviews, I coded data to find information to provide material for making the second round of interviews more detailed. By observing the second PD program, I was able to enrich the discussion during the second round of the interviews. The second round of interviews allowed me to collect information in response to the second PD program. Following all interviews, I analyzed data by coding interview transcripts and looking for patterns.

I modeled my study after Ogbomo's (2002), with an observation of a professional development program, a group interview, and individual interviews in an attempt to triangulate data and build a thorough case study of the professional development experiences of teachers at this school. The group interview included all of the teachers, except for one, and the science department chair. The individual interviews included these individuals, as well as a principal in the district. My interview questions are modeled after Ogbomo's questions, emphasizing self-efficacy, which was only one of her focuses.

3.3 Participants

In this section, I will describe the individuals that participated in the study. I will describe the school district in more detail, along with the secondary science department within the district. Lastly, I will describe the individuals that were interviewed and provide narratives of each of them to illustrate their backgrounds.

The inquiry took place in the science department of a large suburban school district. The district is one of the top-ranked districts in the state on multiple lists and boasts many AP classes and National Merit Finalists. 100% of its high school teachers are considered "Highly Qualified" by No Child Left Behind, which means they have "1) a bachelor's degree, 2) full state certification or licensure, and 3) prove that they know each subject they teach" (U.S. Department of Education). Less than 5% of students are eligible for free or reduced-price lunch.

This district has a rate of teacher turnover that is approximately one-tenth of the national average of 16.4% (Ingersoll & May, 2012). It is regarded locally as one of the best districts to attend as well as to work. It also has a dedicated department of teacher learning, which focuses on

organizing professional development for the district. The district receives high ratings from various rating websites in academics, teacher quality, clubs and activities, college preparation, and safety. Nearly all students graduate in four years.

The secondary science department in this district covers students in grades 6-12. There are three middle schools, an intermediate 9-10 high school, and a senior 11-12 high school. There are approximately 50 secondary science teachers in the district. All teachers within the secondary science department often attend professional development together at the senior high school, even those who teach in the other buildings.

Each of the middle schools has a principal and an assistant principal, and each of the high schools has a principal and two assistant principals. Although department chairs serve as both teachers and administrators, I considered them administrators for the purpose of this inquiry, because serving in an administrative capacity can provide a different viewpoint than that of individuals who teach only.

The science department has a reputation for high performance as well. The department offers a varied curriculum with many choices for students, including several Advanced Placement science courses. The district has nearly three times the state average of Advanced Placement science course participation. The stated goals of the department include a focus on STEM and 21st century learning skills, such as creativity and collaboration. The district emphasizes a strong science curriculum throughout the elementary and secondary levels.

I distributed a demographics survey (Appendix A) to all of the teachers through the department chair and 12 teachers participated, but only four teachers indicated they were willing to complete individual interviews. The survey results for these four teachers are found in Figure 4. Of these four teachers, three have been teaching at this district for between 11 and 20 years

including this year and one teacher was in her first year in the district. Three of these teachers have a bachelor's degree in science and one has a dual degree in a science and education. All of these teachers attended a college or university within the same state the study was conducted, as did both of the administrators. Of the four teachers who participated, all of them had teacher certifications in multiple content areas within science. These demographics generally matched those of the 12 teachers I surveyed, except that the teacher in her first year in the district was the only teacher new to the district who took the survey. Also, two of the four teachers interviewed serve as union representatives, which is disproportionately high compared to the 12 surveyed.

Previous research has shown that teachers with different amounts of experience can perceive the same professional development differently (Covay Minor et al., 2016). Research also shows that between one-third and one half of teachers leave the profession within their first five years of teaching (Beebe, 2013). As a result, I aimed to include a teacher in her first five years of teaching within the sample.

The administrators have both been in the district for at least 11 years. The science department chair was recruited through a mutual colleague and agreed to help recruit the other participants. He invited the principal who participated, since this middle school principal had previously been helpful for the science department.

All individuals will be described using pseudonyms. Figures 4 and 5 summarize data about the participants collected during the initial demographic survey. I used this sample of teachers and administrators to create a detailed snapshot of professional development opportunities within the science department I investigated and how they impact science teachers' beliefs of efficacy and perceptions of professional autonomy.

Pseudonym	Role	Years in District	Years in Education	Undergraduate Degree	Additional Degree
Angela	Full-time biology, physics, and chemistry teacher	1	5	Biology and Secondary Education	N/A
Kevin	Full-time biology teacher; union representative	11-20	11-20	Biology and Chemistry	N/A
Nicole	Full-time physics teacher	11-20	11-20	Physics	M.Ed in Secondary Science Education
Michael	Full time gifted program teacher; union representative	11-20	11-20	Chemistry	M.Ed

Figure 4. Summary of teachers

Pseudonym	Role	Years in District	Years in Education	Undergraduate Degree	Additional Degree
Dave	Part-time physics teacher; science department chair	11-20	11-20	Applied Physics	M.Ed in Curriculum Instruction
Robert	Full-time building principal	11-20	11-20	Elementary Education and Special Education	M.Ed, Ph.D in Organizational Leadership

Figure 5. Summary of administrators

In the following section, I describe each participant. The information contained in the narratives was collected in interviews, emails, and phone calls with the individuals.

3.3.1 Michael: An Unusual Point of View

Michael describes his “rare path” to his current role. He began teaching in this district with no previous teaching experience after he received his certification, which he described as unusual. After teaching Chemistry and Environmental Science for several years, he took on an instructional coach role, helping the district implement technology in classrooms. His current role is teaching

enrichment classes as part of the district's program for gifted students. He also has a leadership position in the local teachers' union.

Michael mentioned during his interviews that he knows a lot about teachers' thoughts on PD from his work with the union. He often talked about what other teachers did or didn't do, or what other teachers did or didn't think. He also emphasized the importance of relationships in the district, including relationships between teachers, between teachers and administrators, and between teachers and students. Michael was least likely to agree with the administrators on ideas about efficacy and autonomy.

3.3.2 Angela: New to the District

Angela joined the district this year, although she previously taught for four years in a different state. She almost always described PD programs in the district in a positive way. She mentioned she preferred some programs, such as the departmentwide PD, over others, such as districtwide PD, although she still found value in all of the programs she described. She found value in collaborating with other teachers over their shared content area, as well as hearing a speaker address the entire district. She also talked more about self-efficacy than any of the other themes, including describing a few ways that PD improved her beliefs of self-efficacy that no other teachers mentioned. She was the only teacher that said she did not participate in any programs outside of the district due to the time limitations of a new teacher in a district, but did mention additional PD she participated in: she had required classroom observations and meetings surrounding these observations because she was new to the district.

3.3.3 Nicole: Valuing Professional Autonomy

Nicole is an experienced physics teacher, having worked in this district for more than 11 years. She teaches full time and assists with a large after-school program. She also mentioned time commitments outside of school that relate to her school-aged children. Nicole talked more about autonomy than anyone else, both in terms of autonomy within her classroom and in the PD programs she attended.

Nicole tended to focus on what she was able to take away from PD programs she may not have found ideal. For example, during the student presentation fair of the Technology Program, she described it as “overwhelming,” but talked about how she was able to focus only on the presentations that were relevant to her classroom. Similarly, she talked about a self-directed web-based program she took through the state Department of Education, that was not useful for its content, but she appreciated that it forced her to reflect on her practice.

3.3.4 Kevin: Advocate of Collaboration

Kevin has been in the district for more than 11 years and has a background in science, but no degree in education. He is also a representative of the local union chapter. He cited his union role often when talking about a variety of topics, including his knowledge of what many other teachers thought. He spoke about collaboration a greater percent of the time than anyone else interviewed. He talked at length about collaboration in multiple contexts. In fact, he had the second highest number of coded segments for collaboration in one interview, after only Angela. He valued time to share instructional strategies with other teachers within the same content area, but also appreciated having opportunities to engage in more long-term science department planning across

multiple content areas. He mentioned a particular diversity training program that allowed him to hear the thoughts of members of the community he doesn't usually speak with, including administrators and custodians.

3.3.5 Dave: A Combined Viewpoint

Dave, who serves as both a classroom teacher and an administrator, was included as administrator for the purpose of the study, but often provided answers that were more similar to those of other teachers' than the answers of the other administrator. Dave is the science department chair in this school district. He teaches half of a full-time teaching schedule, in the morning, and then uses the afternoon for administrative duties. He is in charge of science-specific curriculum at the secondary level, including observing and coaching teachers. In his own words, he oversees "course requirements, scheduling issues, textbook decisions or curriculum, what's actually taught, how it relates to the standards." He acts as a "go between between administration and teaching... overseeing science curriculum." Dave is responsible for organizing, and often leading, science departmentwide PD. Dave was helpful in gathering participants for this study. Teachers also greet him warmly and choose to engage in conversation, which suggests he has a good relationship with the teachers in the department.

Dave was included in the study as an administrator, although his interview responses had much in common with both teachers and the other administrator, Robert. For example, when describing the PD on March 29, he shared takeaways he was able to implement in his own classroom, as the teachers did, but also discussed some of the big-picture goals of the program and how other teachers implemented what they learned, which other teachers did not discuss. When Dave first spoke during the group interview, he began by sharing the feedback on PD he has

received from other teachers and what his plans have been for improving it. His big-picture insights on PD in the district were helpful in refining the interview questions, such as his initial description of the different types of PD programs as districtwide, schoolwide, and departmentwide. Dave was more likely to agree with the teachers' ideas about self-efficacy and collective efficacy than Robert was.

3.3.6 Robert: Looking at the Whole

Robert has been working in the school district for nearly 20 years. He started as an elementary special education teacher, which matches his undergraduate degree. He has since earned a Ph.D in Organizational Leadership and serves as a building principal for one of the secondary schools in the district. He does not work specifically with the science department, but was interested in participating in the study from an administrator point of view. Robert talked about collective efficacy a greater percentage of the time than any of the others interviewed, and was more likely to talk about the big picture of year-long PD planning.

3.4 Instruments

My primary research question is: *Do science teachers have opportunities to engage in PD that supports the development of self-efficacy, collective efficacy, and sense of professional autonomy?* I have further broken this question down into several parts, which I have answered by analyzing data from interviews I gave to science teachers and administrators.

The design of the interviews is adapted from Queen Ogbomo's (2002) Ph.D dissertation. Ogbomo was investigating how specific professional development programs at museums changed the way teachers teach and think about science, including the impact on their beliefs of self-efficacy. Her study consisted of six case studies of individual elementary school teachers. Her study included surveys as a primary source of data, along with classroom observations and teacher interviews to triangulate the data in the surveys (Ogbomo, 2002).

Ogbomo's (2002) survey resembled the Science Teaching Efficacy Belief Instruments, STEBI-A and -B, which have been shown to be effective and reliable for measuring teachers' beliefs of self-efficacy (Deehan, 2017). Additionally, the STEBI-A and -B instruments have been used to develop qualitative, in-depth interview protocols (Deehan, 2017). Ogbomo (2002) adapted STEBI survey questions to develop her interviews as well, and I modified her interview questions for my inquiry as described in the following paragraph. I will be modifying these instruments for interview questions, although I will not be measuring efficacy.

For the design of my interview protocols, I began by selecting the questions from Ogbomo's protocols that were most relevant to my inquiry, which I used in both the group and individual interviews. The group interview protocols are shown in Appendix B and the individual interviews are shown in Appendices C-G. These questions asked how teachers will be able to apply what they learned in the program to their classroom teaching. Since Ogbomo's research specifically addressed self-efficacy and its effects from one program, I then adapted these questions to also address collective efficacy and professional autonomy.

For example, one question in the individual interviews that addresses self-efficacy is "How did this professional development program impact your ability to provide good instruction?" The

following question, which is designed to address collective efficacy, asks, “How did this professional development program impact your school’s ability to provide good instruction?”

Additionally, I considered the recommendations of Skaalvik and Skaalvik (2007), who explored the reliability of various measures of self-efficacy and collective efficacy. While the instrument items they recommended were Likert-scale type questions, I adapted the most direct questions into open-ended questions or follow-up probing questions with the intention of acquiring more detail about the participants’ beliefs of self- and collective efficacy as they relate to the professional development program. I also incorporated the ideas of Ginns, Tulip, Watters, and Lucas (1995), who had explored the impact of a professional development program on teachers’ beliefs of self-efficacy as well. While I am not directly measuring the impact of the program on teachers’ beliefs of self-efficacy, I will be exploring whether teachers thought the program impacted their beliefs of efficacy and autonomy. I used phrases directly from Ginns et al.’s (1995) work to serve as probes to further direct the conversation.

For the questions relating to professional autonomy, I used the definitions of professional autonomy that were described by Pearson and Moomaw (2005). I replaced the descriptions of efficacy in those questions with simplified definitions of professional autonomy, so that the questions appeared similar to the questions Ogbomo (2002) had used while also addressing professional autonomy. Teachers raised the idea of autonomy, using that word specifically, during the group interview, so I was able to ask about it directly during the individual interviews. An example of a question that directly addressed professional autonomy is “Autonomy was mentioned in the group interview. Do you think the PD impacted how much autonomy you feel you have in your classroom?”

My interviews attempted to address all sub-questions as well. Sub-question A is: *What do teachers think is available to them?* The group interview provided insight into this question, which was adapted from Ogbomo's (2002) and Ginns et al.'s (1995) interview questions about the teachers' beliefs resulting from professional development programs. The individual interviews provided an opportunity to further dive into the information suggested during the group interview.

The interview protocols for administrators was given to administrators to address Sub-question B: *What do school leaders think is available to teachers?* These questions mirror the questions in the group interview and teachers' interview, except that they could be answered by individuals who did not participate in the professional development programs being investigated and do not necessarily teach in their own classroom. They are worded similarly to the questions in the teachers' interviews, but do not ask about personal experience in the program. This provided insight into the differences between how teachers and administrators view professional development opportunities. For example, the administrator's interview includes the question "How did this professional development impact the teachers' ability to provide good instruction?" This question will help me understand how the administrators feel professional development affects teachers' self-efficacy, rather than the self-efficacy of the administrators.

Sub-questions C and D ask: *How do teachers and school leaders think these opportunities impact teachers' self- and collective efficacy?* and *How do teachers and school leaders think these opportunities impact teachers' perceptions of professional autonomy?* The individual interview questions are designed to answer this question, and are also based on Ogbomo's (2002) and Ginns et al.'s (1997) interview questions. Additionally, I adapted questions in this interview from Lee et al.'s (2011) questionnaire questions designed to evaluate teachers' collective efficacy, since Ogbomo did not address collective efficacy. These questions, especially the series of probing

follow-up questions, have been designed using the recommendations of Skaalvik and Skaalvik (2007) for measuring teachers' self-efficacy and collective efficacy. Lastly, I used Pearson and Moomaw's (2005) definitions of professional autonomy to adapt the questions to specifically address professional autonomy as well.

Lastly, Sub-question E asks: *What other factors do teachers and school leaders think efficacy and professional autonomy?* The final question in both the group interview and first individual interviews directly asks this question, in case teachers and administrators have ideas that do not fit within my prediction of a link between professional development, efficacy, and retention.

I used the data collected in the group interview to refine the questions for the individual interviews. The questions in the group interview are designed to elicit ideas relating to teachers' thoughts on their professional development experience, with a focus on beliefs of efficacy. If teachers made any statements that directly relate to my inquiry questions, I used their statements to promote more targeted discussion during the individual interviews. For example, several teachers raised the idea of professional autonomy during the group interview, so I was able to build on this idea during the individual interviews by asking teachers to respond to the statements they heard in the group interview. I was able to steer the discussion towards the answers to my inquiry questions, while still hoping to allow teachers to feel they are in control of the conversation.

3.5 Analysis and Interpretation

3.5.1 Data Reduction

Miles and Huberman (1984) argue that researchers need to explicitly describe the analysis procedures used in qualitative research, with a focus on data reduction, data display, and conclusion-drawing/verification. Once I collected interview data, I transcribed the interviews using transcription software and confirmed the accuracy of transcription by listening to the tapes myself.

After transcribing the recordings, I separated the transcription into separate units of datum that can more easily and uniformly be analyzed. Each unit was defined as one speaker's answer, described as one excerpt of text. The interviewer's words were not considered data, but split data into separate units. The interviewer's words were also used to determine context of the units. In the group interview, a new unit was counted each time a new speaker spoke. In the individual interview, the new units were separated by the interviewer's questions or other interjections that were more than one word. Once the data from the group and individual interviews were reduced into units, all the data were analyzed together. The data reduction and coding process were completed using the software Dedoose.

3.5.2 Data Display

Once the data were parsed into excerpts, each excerpt was coded for mention of the main themes I explored in my research, described in Figure 6. Each excerpt, if it included mention or discussion of one or more themes theme, was coded with any codes that apply. Figure 6 lists the

Themes	Phrases that may identify theme:
<p>1. Self-efficacy: the belief in one’s capabilities across multiple situations and environments</p>	<p>Anything that relates to feeling more effective in the classroom, helping students better, or learning new strategies to improve instruction Can be positive or negative Examples: “The program gave me confidence”, “The program helped me become better at...” "It helped me teach" "I walked away with something I could use in my classroom" "I didn't walk away with something I could use in my classroom", “Helped me in my classroom” Administrator mentioning that PD helped individual teachers feel more effective in the classroom</p>
<p>2. Collective efficacy: the application of self-efficacy to a group or organization</p>	<p>Anything that relates to thinking other teachers or the whole school is effective at teaching students Can be positive or negative "It helped our school" "It helped our department" "It was useful for other teachers" "It pushed us in our classrooms." “Other teachers find it helpful”</p>
<p>3. Professional autonomy: teachers’ perceptions of the “degree of individual teacher control in their classrooms” over factors such as curriculum, student management and evaluation, and pedagogical techniques</p>	<p>Anything that relates to teachers feeling that they do or do not have more choice in their classroom or the ability to make instructional decisions “The program made me feel like I could decide on my own...” "It gave me the choice to..." “It allowed me the freedom to decide...” "I could adapt..."</p>
<p>4. Collaboration</p>	<p>Anything that relates to teachers working together or sharing ideas “It was great to get together with colleagues” “We never get to see other teachers in our subject area”</p>

Figure 6. Themes to identify while coding and examples

coding guide to different themes, their definitions, and possible phrases to help identify the themes while coding. The fourth theme, collaboration, was identified as a common theme during the process of transcription of data analysis, and was made a separate code in order to better look for patterns relating to collaboration.

3.5.3 Conclusion-Drawing

I focused on the existence of these themes, the prevalence of these themes, and the depth of discussion of these themes. The existence of these themes will simply be a count of how many times each theme is mentioned.

<p>Analysis - Conclusion-Drawing</p> <p>Existence of Themes</p> <ul style="list-style-type: none">● How many times mentioned● Compare mention of themes by teachers to mention of themes by administrators <p>Prevalence of Themes</p> <ul style="list-style-type: none">● How often mentioned in direct response to question or probe● How often mentioned when an interviewee begins a new idea● How often mentioned in a group interview● How often mentioned in individual interviews● Compare prevalence of one theme to all the others● Compare prevalence of one theme to another theme● Compare prevalence in teacher interviews to prevalence in administrator interviews <p>Depth of Discussion of Themes</p> <ul style="list-style-type: none">● If one theme is mentioned, how much does interviewee discuss it?● How long is spent discussing each theme?● What level of detail is included in discussion of each theme?● Which themes provoke the most discussion from other teachers? <p>Sequences of Connections</p> <ul style="list-style-type: none">● Does one theme often appear with another?● Does one theme lead to another?
--

Figure 7. Patterns for drawing conclusions

I looked deeper into prevalence of these themes by exploring how often the themes are discussed in different contexts, as described in Figure 7. I explored the nature of connections

between the themes by looking at the depth of their discussion, as well as sequences that occur regularly throughout the data.

3.5.4 Answering Inquiry Questions

By exploring the themes described in the previous sections, I hope to answer all parts of my primary inquiry question, *Do science teachers have opportunities to engage in PD that supports the development of self-efficacy, collective efficacy, and sense of professional autonomy?*, by answering all of the sub-questions. Figure 8 describes how I plan to answer all of the sub-questions and create a detailed picture of this snapshot of science teachers.

3.5.5 Reliability

A codebook was written so that the data could be coded reliably and consistently by me and the second coder I recruited to help with the study. The codebook included definitions of all terms used, as well as examples and notes that could provide further instruction for identifying the presence of a code. The codebook also included a glossary of terms and abbreviations that occurred in the interviews that may not be immediately clear to an individual outside the school district. The codebook was revised in collaboration with the second coder.

The second coder initially coded approximately 10% of the excerpts. Whenever evaluation differences occurred between the second coder and me, we discussed each case and decided on a consensus evaluation and the codebook was revised. We then coded another 10% of the excerpts, and found that the overall consensus rate was 90% on the 20% of excerpts that were double-coded.

Sub-Question	Plan for Answering Question	Themes Mentioned (Figure 6)
What professional development do science teachers think is available to them?	Summarize answers from group interview and individual teacher interviews that talk about the availability of PD programs.	
What do school leaders think is available to teachers?	Summarize answers from group interview and individual administrator interviews that talk about the availability of PD programs.	
How do teachers and school leaders think these opportunities impact teachers' self- and collective efficacy?	Summarize answers from group interviews and individual interviews coded as Themes 1 and 2 (Figure 6). Identify patterns in answers coded as Themes 1 and 2 (Figure 6) according to data analysis table (Figure 7).	1. Self-efficacy 2. Collective efficacy
How do teachers and school leaders think these opportunities impact teachers' perceptions of professional autonomy?	Summarize answers from group interviews and individual interviews coded as Theme 3 (Figure 6). Identify patterns in answers coded as Theme 3 (Figure 6) according to data analysis table (Figure 7).	3. Professional autonomy
What other factors do teachers and school leaders think support efficacy and professional autonomy?	Summarize answers from group interviews and individual interviews coded as Theme 4 (Figure 6) and uncoded excerpts that mentioned factors that improve self-efficacy, collective efficacy, and autonomy.	4. Collaboration

Figure 8. Intended strategy for answering inquiry questions

3.6 Positionality Statement

As an educator, I came into this inquiry with my own experiences with professional development for science teachers. I began teaching secondary science with a degree in Biology, and pursued my teacher training during my first years teaching. I taught secondary science for six

years in three different schools. Nearly all of my students were from low socioeconomic backgrounds and the schools ranged in reputation and academic performance. In all three settings, I was unsatisfied with the PD offered, often for the same reasons. I often felt that science content-specific pedagogy was neglected during PD and that there was an overemphasis on meeting statewide and districtwide requirements, sometimes at the expense of programs that I felt would have been more useful to me as a teacher. As a result, I was eager to explore the reasons that science teachers find PD helpful, and whether science teachers have access to these such programs.

4.0 Results

The data presented in this chapter will be used to provide insight into the nature of what PD opportunities are provided to science teachers in the district studied. The data will primarily address whether these opportunities encourage science teachers' beliefs of efficacy and perceptions of professional autonomy. The data are based on interviews with four teachers and two administrators from the science department of a suburban school district, including one group interview and two interviews with each individual.

Section 4.1 summarizes the professional development opportunities available to science teachers in the district studied. Sections 4.2, 4.3, and 4.4 present the findings on the impact of professional development on teachers' beliefs of self-efficacy, collective efficacy, and professional autonomy, respectively. Section 4.5 describes other factors that can impact perceptions of efficacy and autonomy. Lastly, Section 4.6 describes additional findings, including results relating to collaboration, reflection, and accessibility of PD programs outside of the district.

4.1 Professional Development Available to Science Teachers

Both teachers and administrators were asked in interviews about what professional development opportunities are available to science teachers at the school district studied. Answers included descriptions of specific professional development programs as well as broader categories of programs. While many of the programs were described by both teachers and administrators, there were some differences in what details were mentioned as well as how accessible those

opportunities are to science teachers. The information provided by teachers and administrators during the interviews was used to answer inquiry sub-questions 1a and 1b: *What professional development do science teachers think is available to them?* and *What do school leaders think is available to teachers?*

Both teachers and administrators described PD in four broad categories: districtwide PD, buildingwide PD, departmentwide PD, and PD opportunities outside the district. These categories were initially mentioned by Dave, the department chair, in the group interview, and then each individual provided further descriptions of these categories during the individual interviews. Each category was discussed by all interviewed participants, either after being asked directly about the category or when asked about the experiences they have had that impacted their efficacy and autonomy. The list of PD programs available to science teachers is shown in Figure 9. These categories also fit my experiences with PD in each of the teaching positions I have had.

The professional development opportunities were described in the group interview as well as each of the individual interviews. Most programs in the district were described in the group interview, with all teachers agreeing that they had the same opportunity. Most of the programs outside the district were described by individual teachers during their interviews. All participants shared the most details about the two most recent professional development programs, which the researcher attended. Several individuals suggested that they were most readily able to discuss these programs since they were so recent. They were also asked about these programs specifically, whereas they were not asked specifically about any other individual program during the interviews.

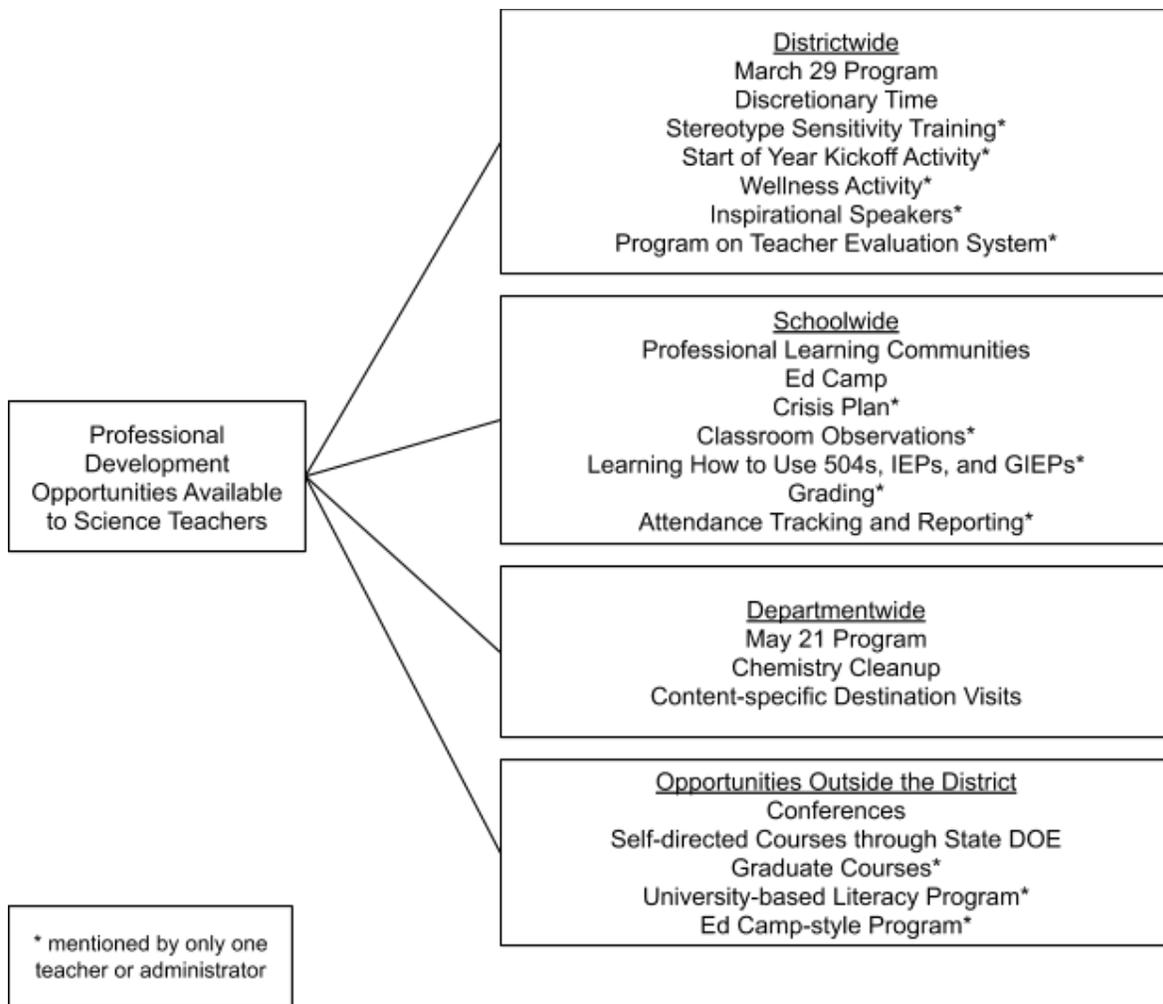


Figure 9. Summary of professional development opportunities available to teachers as reported by teachers and administrators

4.1.1 Districtwide PD

Districtwide PD consists of programs that are provided by the school district. All teachers are required to participate unless they are busy with other school-related work, such as field trips. Teachers at all grade levels K-12 and all content areas participate in the same program. Teachers described these programs as broad, about students in general rather than about their specific students, and designed for the purpose of meeting district or state requirements. One teacher

described these programs as bad, but “not useless.” Details about the districtwide PD opportunities available to teachers are described more in Figure 10.

The most information was shared about the Technology Program on March 29, which I had attended. All interviewed participants discussed this program. Both teachers and administrators described a motivational speaker and student presentation of technology applications. The principal, Robert, also described the program’s introduction provided by the superintendent and multiple teachers mentioned brief presentations about technology applications in the classroom by other teachers.

Teachers and administrators described the goals and strengths of the program differently. Multiple teachers described the program as not necessarily related to their specific content areas, but having provided general strategies that could be applied to the science classroom. For example, Nicole, a teacher, said,

“I know that I hadn’t necessarily [gotten] any extra information about it, but I did, I find like motivational, inspirational speakers, people coming from other areas, bringing in a new perspective into the, into the mix is always kind of a cool, fresh thing for me. I appreciate those opportunities to hear somebody else’s perspective....I did walk through the elementary to see, okay, what are these kids doing that are bringing them to my class?”

Kevin, a teacher and union representative, mentioned that these strategies could be implemented with the guidance of a technology-focused instructional coach.

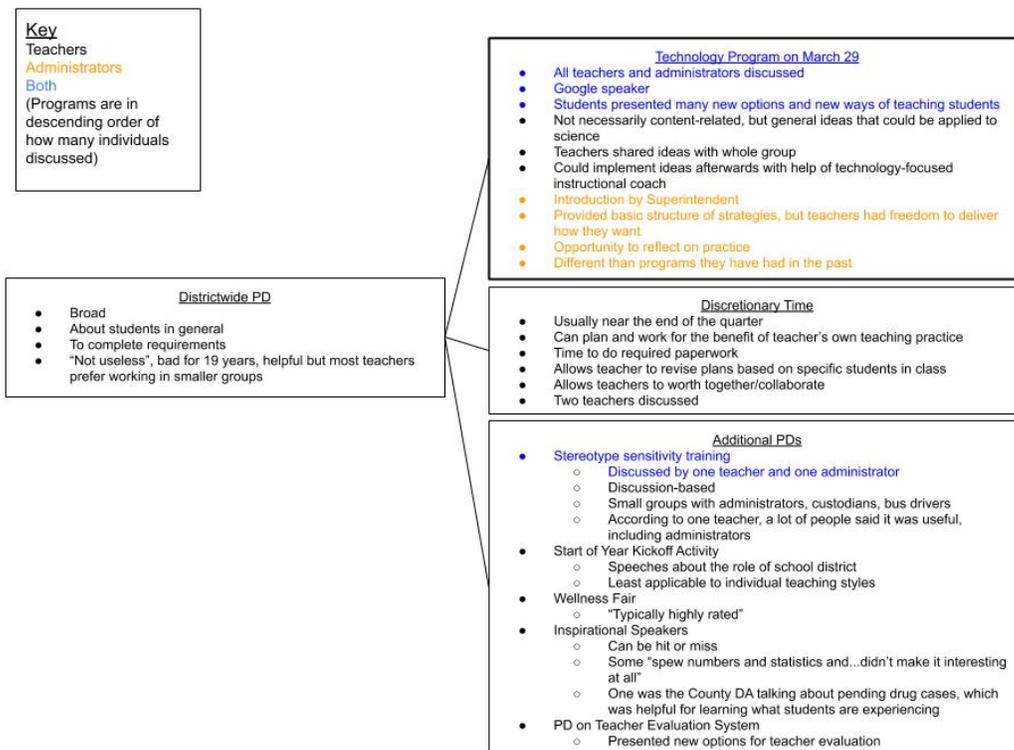


Figure 10. Districtwide PD available to science teachers as described in interviews and in order of how many teachers, administrators, or both discussed

The administrators, on the other hand, emphasized the autonomy encouraged by the program, in that the program provided the basic structure of instructional strategies, but allowed teachers the freedom to deliver instruction how they want. Robert, the principal, mentioned that the program provided an opportunity for teachers to reflect on their practice and that the program was exciting because it was different from programs they have had in the past.

There was only one program, or category of program, that more than one teacher described. However, this may be due to the fact that many of the programs were initially mentioned during the group interview, when other teachers could hear and decide they didn't need to describe the same program as well. Dave, the department chair, and Angela, the new teacher, mentioned districtwide discretionary time. They described it as a subset of the general category of districtwide

PD, rather than as a specific PD program. According to these two individuals discretionary time is usually scheduled near the end of the grading quarter. It allows teachers time to do required paperwork and to plan and work for the benefit of the teacher's own teaching practice. It allows teachers time to revise plans based on the specific students in their classrooms as well as time to collaborate with other teachers. Dave discussed discretionary time when asked about it, but focused on its limitations, such as the difficulty in holding so many teachers accountable for accomplishing something during this time.

Both Kevin and Robert described a particular districtwide PD program on stereotypes and diversity. The program was described as discussion-based among small groups that included teachers, administrators, and school staff such as custodians and bus drivers. According to Kevin, the union representative, a lot of teachers and administrators said the program was useful. He discussed the program at length during the group interview, so it was not asked about during the individuals, and he was the only teacher who mentioned it during the individual interviews.

Lastly, there were a few specific districtwide programs or types of districtwide programs that were described by only one individual each. There was no disagreement on which programs were available, although some were only mentioned during individual interviews, so other teachers did not have an opportunity to voice disagreement in those cases. Each individual program was recalled by a different teacher. These included: Angela, the new teacher, described a school year kickoff activity, which included speeches about the role of the school district and was described as least applicable to individual teaching styles; Robert, the principal, described a wellness fair, which is "typically highly rated" whenever it is offered; Michael and Robert described multiple programs with inspirational speakers, which can be "hit or miss" and can occur several times a

year; and Kevin, the union representative, described a particular program on the district's teacher evaluation system, which presented new options teachers could choose for professional evaluation.

In addition to discussion about current PD opportunities, Michael talks about his work with the district to improve PD, since there is currently a lot of unhelpful PD. He often talks about preferring less structured programs, such as discretionary time, collaboration time, or co-planning time. He is working with district balance "compliance stuff," or state and district requirements for continuing education for teachers to maintain their certification and position, and PD that is more applicable to the classroom. His biggest complaint is "they give us stuff that they think we need without actually talking to us" and that this has been a problem for the last decade. He serves on a committee to improve PD, working between teachers, union, and administration to improve PD going forward. He says that some new ideas from the committee look promising, but is unsure whether they will be implemented.

Teachers and administrators often described districtwide PD as their least preferred type, since it is least relevant to their classroom. This is similar to my own experiences with districtwide PD programs. However, teachers and administrators also talked about several ways they found these programs useful, especially when asked specifically about the impact of these program on their beliefs.

4.1.2 Buildingwide PD

According to teachers and administrators, buildingwide PD programs are required for all teachers within a single building in the district, such as a middle school (grades 6-8) or the senior high school (grades 11-12). These programs are often run by the building principal. All teachers described buildingwide PD programs as procedural and necessary, especially for new teachers,

although Kevin mentioned they might also be overwhelming to a new teacher. The programs cover the day-to-day workings of the school. Dave mentioned that each principal runs their buildingwide programs differently, some leaning towards discussion-based programs and some relying on presentation-based programs. Details about the buildingwide PD opportunities available to teachers are described more in Figure 11.

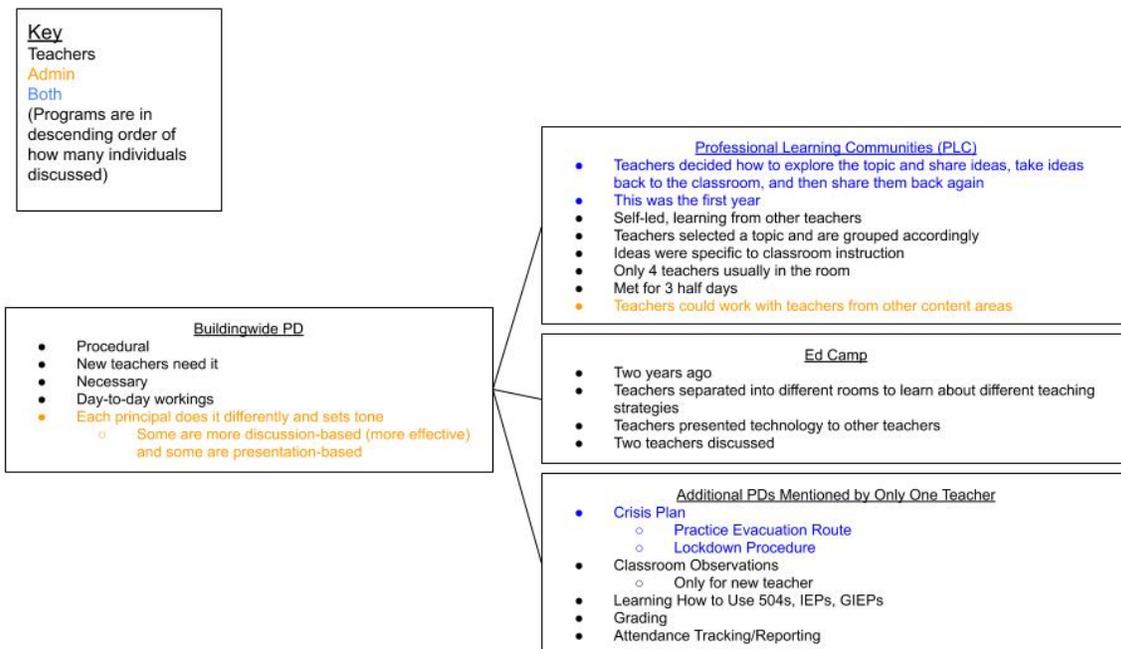


Figure 11. Buildingwide PD available to science teachers as described in interviews and in order of how many teachers, administrators, or both discussed

During the group interview, several teachers discussed professional learning communities (PLC) as a category of buildingwide PD. As a result, the first round of individual interviews included a question about PLC, so all teachers shared their thoughts on PLC. This school year was the first time the district had PLC programs. Both teachers and administrators described PLC as guided by teachers’ decisions on how to explore a topic and share ideas, take ideas back to the classroom, and then share them back again. Only teachers described PLC as self-led and primarily

involved learning from other teachers. Teachers were able to select a topic and were grouped according to their chosen topics. The ideas discussed were specific to classroom instruction and the groups were small, often with about four teachers in attendance per group. The group met for three half-days. Dave also emphasized the advantage of teachers having the opportunity to work with teachers from other content areas.

Nicole and Angela discussed Edcamps, which are PD programs described similarly to PLC, in that both are described as teacher-led and allowing for teacher choice in topic. Edcamps involve teachers being separated into different rooms to learn about different teaching strategies based on their own interests, as well as teachers presenting strategies to other teachers.

Additionally, there were a few specific buildingwide PD programs mentioned by only one teacher each: Kevin, the union representative, described a crisis planning PD that showed teachers lockdown procedures and allowed them to practice the evacuation route; Angela, the new teacher, described classroom observations and feedback for new teachers; and teachers in the group interview described a program that showed teachers how to use special education procedures, a program that showed teachers grading procedures, and a program that showed teachers attendance tracking and reporting procedures.

Overall, the teachers and administrators both described buildingwide PD as necessary, but less specific to classroom instruction than departmentwide PD.

4.1.3 Departmentwide PD

Departmentwide PD is separated by content area, so all of the secondary science teachers participate in the same program. Science teachers in the middle school and intermediate high school will often travel to the senior high school to attend. These programs are often run or

organized by the department chair. Each department has its own principal that oversees it, but that principal is not often present at departmentwide PDs. Science teachers that were interviewed described departmentwide PD as the most helpful type of PD for science teachers, because they are most likely to learn relevant instructional strategies compared to broader programs like districtwide PD. Teachers also mentioned that departmentwide PD often includes time to work on tasks assigned by the district, such as project-based learning lesson planning, common assessments, unit planning, curriculum planning, and syllabus planning. These programs often have built-in collaboration time, which teachers described as an opportunity to get together with other teachers in the same specific content area, such as biology or chemistry, and compare what each teacher is doing in the classroom. Details about the departmentwide PD opportunities available to teachers are described more in Figure 12.

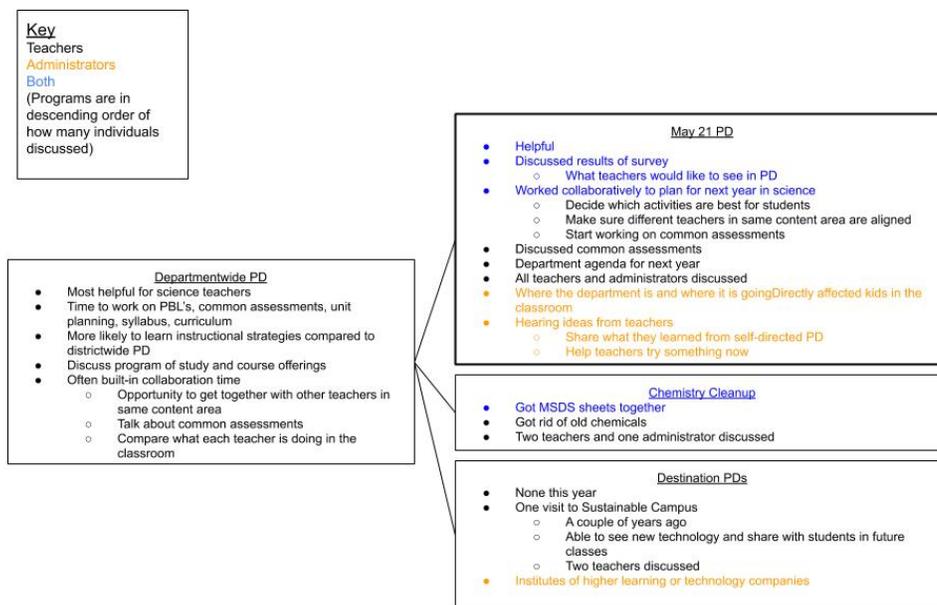


Figure 12. Departmentwide PD available to science teachers as described in interviews and in order of how many teachers, administrators, or both discussed

The second PD program I attended was on May 21 and was an End of Year Science Department Program. Both teachers and administrators described this program as helpful and including collaborative work time to plan for next year and science. Both teachers and administrators were asked about a survey provided previously by the department chair, who shared the results during this session. All teachers and administrators were asked directly about this program during the interviews and all participants shared thoughts about it.

Teachers described other parts of the programs, including time to discuss common assessments and a presentation of the department agenda for next year. Teachers also mentioned that the collaborative planning time was useful for deciding which activities were best for students, making sure different teachers in the same content area are aligned, and starting to work on common assessments. Dave, who ran the program, also mentioned that the program included a presentation on where the department is currently and where it is going. He also mentioned the opportunity to hear ideas of successful strategies directly from teachers, so teachers could share what they learned in self-directed PD and encourage others to try something new.

During the group interview, two teachers and Dave described one block of dedicated PD time during this school year that was focused on cleaning up the chemistry laboratories. Science teachers disposed of old chemicals and organized the safety paperwork for the remaining chemicals.

Lastly, two teachers during the group interview, as well as Robert during his individual interview, discussed department field trip-style PD programs, of which there were none this year. They described a visit to a sustainable school campus several years ago, where they could see new technology and share the technology with students in classes. Robert, the principal, also mentioned visits to institutes of higher learning and technology companies.

Teachers and administrators described departmentwide PD as most preferred by teachers because it was most relevant to their classroom instruction. This fits with my own experience as a teacher.

4.1.4 PD Opportunities Outside of District

The final category of programs described by teachers and administrators is PD opportunities outside of the school district. Both teachers and administrators mentioned that some teachers participate in these programs and some do not. Angela said she did not have time to participate in these programs because it was her first year in the district. Both administrators said teachers who do not participate in these programs may be learning on their own instead or are not as motivated to learn.

One type of program outside the district are conferences. According to Nicole and Michael, it is not easy for teachers to get approval to attend a conference unless they use personal days and pay for their own travel. The paperwork to receive permission from the district is a “hassle.” Michael elaborated that “lead learners,” such as department chairs, instructional leaders, and instructional coaches, are more likely to get approval to go to conferences because they have the ability to amplify the message from the conference. The administrators, however, suggested that it was not too difficult for any teacher to get approval to attend a PD program outside of the district. Dave mentioned that approval to attend a conference depends on whether the district has the time or money available, and Robert mentioned that some people may not attend because they are not interested.

Teachers also have the opportunity to take self-directed PD courses through the state’s Department of Education website. Kevin, the union representative, mentioned that teachers could

choose the topic of their course and that these courses were more work than the bare minimum required for to earn PD credit to maintain state teacher certification, but worth the extra work. Nicole, the experienced physics teacher, mentioned taking a course on student anxiety and a course on getting to know students, which she described as useful because it encouraged reflection, but the content was not directly useful. She also spent more of her interview talking about programs outside the district than any other individual interviewed.

Additionally, there were a few PD programs mentioned by only one teacher each: Joyce described graduate courses, which some teachers choose to take on their own and can receive a small pay bump for additional credits; Joyce also mentioned a university-based literacy program that helped teachers incorporate literacy into science; and Michael described an Edcamp-style program, where teachers were able to choose the topic and teachers could contribute to the program.

4.1.5 Summary

In general, there were four types of PD described by teachers and administrators: districtwide PD, buildingwide PD, departmentwide PD, and PD opportunities outside of the district. Teachers tended to find departmentwide PD more applicable to their classrooms, but acknowledge the importance of the other types of PD as well. There was agreement between teachers and administrators about which PD opportunities are available, although teachers sometimes recalled different details of programs than administrators and had different thoughts on how accessible the programs outside of the district were.

While Robert, the principal, usually had ideas that coincided with those of the teachers, he also raised ideas about available PD that no teachers or only one teacher also shared. He often

discussed the intended purpose of a PD program without prompting, compared to teachers who only discussed the intended purpose of a program if they were asked about it directly. Additionally, he talked about longer-term plans for PD. He shared how a program might be planned within the scope of an entire year of PD programs and how PD was planned for the entire district.

4.2 Professional Development and Beliefs of Self-Efficacy

Every teacher and administrator discussed self-efficacy in the individual interviews and several teachers discussed it in the group interview as well. The interviews included questions that were directly and indirectly about self-efficacy. As a result, the group and individual interviews were able to provide insight into inquiry sub-question 1c: *How do teachers and school leaders think these opportunities impact teachers' self- and collective efficacy?* Teachers and administrators shared the ways in which the professional development opportunities in the district impacted their self-efficacy, both improving it and not improving it. Administrators tended to agree on these ways, although there were some mentioned by teachers that were not also mentioned by administrators.

Table 1 in Appendix H summarizes all the different ways teachers and administrators described PD as improving beliefs of self-efficacy, listed in order of decreasing number of teachers who mentioned it. The most commonly mentioned way that PD has positively impacted self-efficacy is the most clearly related to the definition of self-efficacy, which is “the belief in one’s capabilities across multiple situations and environments” (Bandura, 2012). All four teachers and both administrators that were interviewed discussed specific programs improving self-efficacy because teachers learn specific new ideas or strategies they can implement in their own classrooms.

They all mentioned the Technology Program on March 29 as an example of a program that improved self-efficacy in this way.

An example of an interview response that fit this category is from Angela, the new teacher, when she was asked directly how a program impacted how effective she felt in the classroom. She said:

It definitely made me feel like I'm more effective because one of the activities in particular was kind of breaking off and doing this, you could call it, station, where you have a bunch of different quick activities that students do, which gives me more opportunities to teach in different ways.

On the other hand, when Angela was asked a more general question, such as "How did that program affect your classroom?", she answered, "For science specifically, I think it definitely gave me more tools to use in the classroom that I wouldn't say are necessarily science content related and it gave me more technology ideas for the students for sure." Another example of a teacher discussing how PD improves self-efficacy in this way is when Michael said, "People were kind of like, oh, they are, people are actually using this stuff. So yeah, I think if that was their goal, I think it moved the ball a little bit for them." All of these examples show individual teachers feeling more effective in the classroom after learning new instructional strategies.

The second-most commonly mentioned way that PD improves self-efficacy is that it helps teachers learn more about their role and expectations of them. All of the individuals interviewed, except for Nicole, the experienced physics teacher, mentioned this. The teachers that talked the most about this were Michael, who recently began teaching classes for gifted students and was able to talk about the gifted program with similar teachers for the first time during the End of Year Science Department PD, and Angela, who was in her first year in the district and appreciated being

able to discuss expectations with other teachers in the same content area. Kevin, the union representative, mentioned buildingwide PD as an example of PD that builds self-efficacy in this way.

A few different ways PD improves self-efficacy were mentioned by more teachers than administrators or vice versa. All teachers except for Angela, as well as Dave, mentioned that PD improves self-efficacy because it helps the teacher learn more about their students. Robert, the principal, did not mention this idea at all, but was not asked about it directly. Interestingly, there was one idea that was mentioned by only the administrators and Angela, the new teacher. They agreed that PD improves self-efficacy because teachers know they are required to do something that everyone else is doing too. It appears that while teachers and administrators have similar thoughts on how PD improves self-efficacy, there are some aspects of self-efficacy that may be more important to teachers and some that may be more important to administrators.

When talking about specific PD programs, Michael, the teacher in the gifted program, mentions that his new role as a teacher for the gifted program means that he doesn't find many PD programs helpful, especially if they are focused on traditional classroom instruction, but that other teachers still might. Specifically, he describes the Technology Program on March 29 as unhelpful because he is "pretty far along the path" with his "ideas about teaching and learning and the necessity of change," although it did "reinforce things" he "already subscribe[s] to." He found the End of Year Science Department PD on May 21 far more helpful because it provided him the flexibility to talk with the other teachers in the gifted program and learn more about his new role. Michael was also likely to raise an idea that no one else did for ways PD impact beliefs of both self-efficacy and collective efficacy.

While no individuals described an instance of PD or other factors causing them to feel less capable in the classroom, all six interviewed individuals described specific ways professional development might not *improve* self-efficacy. In other words, the discussion described here does not talk about self-efficacy being negatively impacted; rather, programs affect self-efficacy neither positively or negatively. Table 2 in Appendix H summarizes all the different ways teachers and administrators described PD as not improving self-efficacy, listed in order of decreasing number of teachers who mentioned it.

Three of the four teachers, and Dave, said that a PD program did not improve self-efficacy because teachers didn't learn anything they could implement in their classroom. An example of a statement like that is "I don't know if I grew a whole lot, but I definitely enjoyed it a lot more," which was used by a teacher during the group interview to describe the experience with PLC. Two teachers and Dave said that PD does not improve self-efficacy if a teacher is told to do something or told it will be effective. Teachers need to see evidence the strategy will be effective. These comments were made in the context of the Technology Program on March 29, when teachers were given evidence of the effectiveness of the strategies for technology use presented by students.

Another way PD may not improve self-efficacy is if it does not include a follow-up opportunity to share the results from trying out new strategies. This idea was mentioned by both administrators, but Kevin, the union representative, was the only teacher who shared this sentiment. Lastly, Kevin mentioned that PD might not improve self-efficacy if it provides too much information to absorb at the time. Although the teacher that mentioned this was not the new teacher, it was a reflection on how his interview answers would be different if he were in his first year of teaching. Both ideas in this paragraph were used to describe PD in general, rather than referring to a specific program teachers had attended in their time in the district.

A quick glance at Table 2 shows that teachers and administrators generally agree on ways that PD might not improve self-efficacy, although teachers emphasized the effectiveness of specific strategies they can use in their classroom more than administrators, and administrators emphasized follow-up on implementation more than teachers.

4.3 Professional Development and Beliefs of Collective Efficacy

Every teacher and administrator discussed collective efficacy in the individual interviews and several teachers discussed it in the group interview as well. The interviews included questions that were directly and indirectly about collective efficacy. The data coded as collective efficacy were analyzed in the same way as the data on self-efficacy. The data provided insight into inquiry sub-question 1c: *How do teachers and school leaders think these opportunities impact teachers' self- and collective efficacy?* Teachers and administrators shared the ways in which the professional development opportunities in the district impacted their collective efficacy, both improving it and not improving it. Administrators tended to agree on these ways, although there were some mentioned by teachers that were not also mentioned by administrators, and vice versa.

4.3.1 Connection Between Self-Efficacy and Collective Efficacy

The teachers often described the school as a collection of individuals, rather than a single cohesive unit. As a result, collective efficacy was often described as self-efficacy for many teachers. For example, if a teacher found a program improved their self-efficacy for any particular reason, they might also say that the program improved their beliefs of collective efficacy because

if the program made them more effective, it probably did the same for other teachers in attendance. An example of an excerpt from Angela that directly linked self-efficacy and collective efficacy is:

The school's ability. Um, well just, I guess it depends on if the teachers took the ideas and actually implemented them in the classroom, so it, it depends on the individual teacher, but as a whole it actually gave us the opportunity to increase the knowledge of instruction. But I don't know that it actually did or not. It depends on the teacher, like I said.

She had been asked how a specific program had impacted how effective the school was overall. The link between self-efficacy and collective efficacy is described by Figure 13.

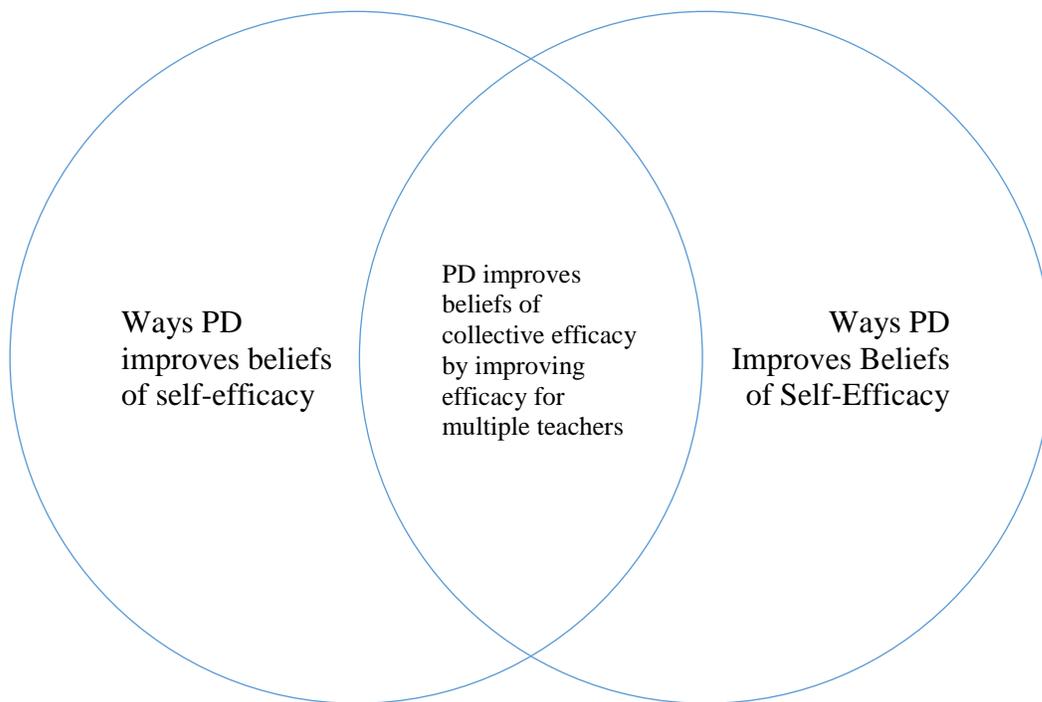


Figure 13. Relationship between self-efficacy and collective efficacy as described in interviews

To better understand the relationship between self-efficacy and collective efficacy, I looked at how often the two codes, self-efficacy and collective efficacy, were applied to the same piece of data. In total, self-efficacy was used as a code for 159 excerpts and collective efficacy was used

as a code 136 times. Both codes were used to describe the same excerpt 113 times. This means that 71% of the time self-efficacy was coded for an excerpt, collective efficacy was also coded. Similarly, 83% of the time collective efficacy was coded, self-efficacy was also coded. The combination of self-efficacy and collective efficacy was the most common co-occurrence of themes in the entire set of data.

Self-efficacy and collective efficacy were nearly always talked about together, rather than having both mentioned separately within the same unit of data. If both types of efficacy had often been mentioned within the same large unit of data, but not related or at the same time, it would not necessarily indicate a link.

Administrators talked more than teachers about collective efficacy, both by itself and along with self-efficacy. This makes sense, because Robert, the principal, did not have his own classroom in which to assess self-efficacy and Dave only spent half of the school day in his own classroom. Administrators also linked self-efficacy and collective efficacy more consistently than teachers did. Thus the highest percent of Robert's answers, compared to any other teacher or administrator, were coded as collective efficacy.

Angela's words described at the beginning of this section directly linked self-efficacy and collective efficacy. An example of an excerpt that was more generally coded as both self-efficacy and collective efficacy is "And then I think the second half was definitely oriented to push us to use it more in our classroom." In this case, Angela, the new teacher, had been asked about the district's intended goal of a districtwide Technology program. She was talking about collective efficacy by discussing self-efficacy of multiple teachers.

Interestingly, some individuals mentioned ways PD improves beliefs of collective efficacy in the greater school context, rather than just in their classroom as an extension of self-efficacy.

Most of the interview questions asked directly about impacts in the classroom, but Dave and Michael, individuals who teach in the classroom but also have duties that affect the school as a whole, suggested ways PD could improve collective efficacy by impacting the school as a whole. They mentioned, for example, schoolwide procedural or safety PD programs. All other teachers interviewed only described these programs as less specific to their classroom, or only described programs that did impact their classroom.

4.3.2 Impacts of PD on Collective Efficacy

Table 3 in Appendix H displays teachers' and administrators' descriptions of PD improving beliefs of collective efficacy. The most common theme raised involving collective efficacy was that PD improves collective efficacy because it makes the individual teacher effective, and the teacher assumes other teachers in the same program are becoming more effective as well. All teachers and administrators who were interviewed mentioned this idea, and they nearly all of the PD programs were described in this context. This idea necessarily includes all the ways that a program can improve an individual teacher's self-efficacy, as long as multiple teachers participated in the same program. The Technology Program on March 29 was the most commonly cited example of this. For example, Angela stated of the program that "it depends on the individual teacher, but as a whole it gave us the opportunity to increase the knowledge of instruction."

Additionally, all of the teachers except Kevin, the union representative, as well as both administrators, mentioned the following ways that PD can improve collective efficacy: PD improves collective efficacy because the teacher got to see or learn about what other teachers are doing in their classrooms, PD improves collective efficacy because the teacher sees other teachers implementing what they learned in the program (usually after the program is complete), and PD

improves collective efficacy because I can develop curriculum and instructional materials with other teachers in my content area. Each of these three ideas involves interactions between teachers, with or without a facilitator or administrator, and either during or after the formal PD program.

Collective efficacy had more ideas that were discussed by only teachers or only an administrator, but not both. Only teachers suggested that PD improves collective efficacy because the teacher gets to help other teachers and share ideas with them, and PD improves collective efficacy because teachers can address organizational and safety concerns across the department. One idea that was stated only by Robert, the principal, but not any teachers was that PD improves collective efficacy because someone from outside the district is recognizing the things the district is doing.

Similar to self-efficacy, there were no instances of an individual describing a scenario in which PD made them feel the organization was less capable. Individuals only described ways that PD had an impact on collective efficacy that was neither positive nor negative. The most commonly cited way PD did not improve collective efficacy was because some other teachers might appear to not be improving their practice. For example, one teacher mentioned other teachers who may not have been engaged during a program, when she said, “some people are probably sitting there on their phones doing whatever”. There was nothing in this category that was mentioned by more than two teachers. All of the ways PD might not improve collective efficacy are listed in Table 4 in Appendix H.

4.4 Professional Development and Perceptions of Professional Autonomy

Professional autonomy was the only one of the themes mentioned unprompted by teachers during the first interview, with the whole group. All teachers and administrators that were interviewed discussed professional autonomy when asked during individual interviews. The group and individual interviews were able to provide insight into inquiry sub-question 1d: *How do teachers and school leaders think these opportunities impact teachers' perceptions of professional autonomy?* Teachers and administrators shared the ways in which the professional development opportunities in the district impacted their autonomy, by improving or decreasing their perception of professional autonomy.

Teachers and administrators were more likely to agree with each other about how PD impacts professional autonomy, compared to the impact of PD on self- or collective efficacy. There were also fewer ways mentioned about how PD impacts professional autonomy compared to the influence on both types of efficacy.

Table 5 in Appendix H lists all the ways teachers and administrators described PD improving teachers' perceptions of professional autonomy. The most commonly mentioned idea was that PD improved a teacher's perception of professional autonomy because the teacher was given a choice of ideas and strategies, and could implement them when and how the teacher wanted. All teachers except for Angela, and both administrators, mentioned this, most commonly in the context of the Technology Program. An example of a quotation that describes this idea was stated by a teacher during the group interview, and before one of the first mentions of autonomy: "And you made it what you needed it to be instead of what somebody else decided that they needed you to do." Teachers felt that being given a choice of strategies without any specific mandated

requirements improved their sense of autonomy in their classroom. An other example from an individual interview is:

If they give us an option, a menu of six or seven things and say you gotta use one of them, that's fine. But if they just show us one and they say you have to use it, I think a lot of times people will dismiss it right away, especially if they don't see the benefit right away.

Three of the four teachers, and two administrators, also mentioned that autonomy within a PD program improved teacher's perception of autonomy in their position and in the classroom. They shared the idea that PD improved the teacher's perception of professional autonomy because the teacher could direct the topic and depth of learning during the PD program. This can include providing input into a formal PD program or deciding how to spend flexible work time independently or in small groups.

Administrators favored the following ideas more than teachers: PD improved the teachers' perceptions of professional autonomy because teachers could take the ideas and strategy from the program and customize them within the classroom; PD improved the teachers' perceptions of professional autonomy because teachers had structured freedom to deliver instruction the way they choose, as long as it fits within the curriculum and standards; and PD improved teachers' perceptions of professional autonomy because teachers were able to contribute ideas to the program. In general, administrators were more likely to describe ways PD improved autonomy than were teachers.

Nicole, the experienced physics teacher, talked more about autonomy than anyone else, including how programs such as that one made her feel more autonomous due to the menu of choices of instructional strategies. She mentioned multiple times that she liked not being expected

to do the same thing as everyone else, whether it is across the building or across her specific content area in the science department.

Unlike the way they described self-efficacy and collective efficacy as being impacted positively or neutrally, teachers and administrators mentioned was that PD *decreased* teachers' perceptions of professional autonomy. Most of the teachers who shared the thoughts in Table 6 in Appendix H were responding to questions about the End of Year Science Department Program, which involved a discussion and task related to common assessments across the content area within the science department. The first idea, which was mentioned by all of the teachers except Angela, and both administrators, is that PD did not improve teachers' perceptions of professional autonomy because teachers were given specific rules to follow in their instruction. These rules related to what teachers were expected to do in their classroom. Nicole stated about these programs "So that is where my mind is right now is lack, losing some autonomy". The second idea relating to the negative impact of PD on perceptions of professional autonomy was that PD did not improve the teacher's perception of professional autonomy because they were working on common assessments, which is a common planning task. Only Nicole mentioned this idea.

4.5 Other Factors that Impact Beliefs of Efficacy and Perceptions of Autonomy

Since the data were coded as self-efficacy in any context, rather than specifying whether PD impacted self-efficacy or whether it was positive, neutral, or negative, it was easy to filter out additional factors that impact self-efficacy. Once the excerpts that related to the positive and neutral impacts of professional development were selected out, the remaining excerpts coded as

self-efficacy were related to other factors that impact self-efficacy. The same process was used to find additional factors that determine collective efficacy and professional autonomy.

Overall, there was little mention of additional factors that impact self-efficacy. Only three individuals mentioned them, and each factor was only mentioned by one individual. These factors are listed in Figure 14.

Self-Efficacy	<ul style="list-style-type: none"> • Having more autonomy improve self-efficacy • Having content expertise improves self-efficacy • Having an opportunity to collaborate with an instructional coach improves self-efficacy
Collective Efficacy	<ul style="list-style-type: none"> • Having more autonomy improves collective efficacy • Knowing that other teachers hired in this district were hired because they're good at what they do improves self-efficacy • Knowing that there is a variety of content expertise in the department improves self-efficacy
Professional Autonomy	<ul style="list-style-type: none"> • Being allowed to teach how I want to teach • Being trusted as a professional • Deciding how each lesson will look • Choosing to do what I want in my classroom

Figure 14. Additional factors that impact beliefs of efficacy and perceptions of autonomy

A similar process was used to find additional factors that impact collective efficacy. As with the additional factors that impacted self-efficacy, each was only mentioned by one individual who was interviewed. The first bullet point relating to collective efficacy is the same as relating to self-efficacy.

Figure 14 also lists the additional factors described by teachers and administrators impacting perceptions of professional autonomy. These factors were mentioned by teachers and administrators alike.

4.6 Additional Factors that Impact Teachers' Perceptions of Efficacy and Autonomy

In addition to the intended data on efficacy and autonomy, other patterns began to emerge from the data. Common themes discussed by teachers include collaboration, reflection, and the accessibility of PD programs outside of the district.

4.6.1 Collaboration

From the first interview, with the group, it was evident that collaboration may be important to teachers and administrators. Collaboration was added to the codebook as “anything that relates to teachers working together or sharing ideas,” including excerpts such as “It’s hard to find that time elsewhere. And now we have the opportunity on that day to engage with our colleagues about making it a better lesson, or you know, a better lab or something.” In the group interview, collaboration was mentioned 13 times, or during 23% of the excerpts, by several teachers and Dave, the department chair.

Throughout the individual interviews, collaboration was mentioned by all four teachers and both administrators. It was not directly asked about during the first round of individual interviews, but was often discussed in the context of the smaller, more specific science departmentwide PD programs.

During the End of Year Science Department Program, collaboration was discussed several times within the program. Dave, who ran the program, mentioned collaboration several times during both the interview and the PD program as a goal of departmentwide PD. He also described collaboration as an aspect of PD that teachers often requested more of. He also mentioned collaboration as the goal of the small group work time in the second half of the program.

Collaboration was mentioned by all of the teachers and both administrators during the second round of group interviews in response to direct questioning by the interviewer. It was mentioned 94 total times, and a similar number of times from each teacher and each administrator. Collaboration was most commonly coded in an excerpt that was also coded self-efficacy or collective efficacy. In fact, 65% of the time collaboration was coded, self-efficacy was also coded; 67% of the time collaboration was coded, collective efficacy was also coded.

4.6.2 Reflection

Reflection was raised as an idea several times during the individual interviews, all without prompting, except when the interviewer was asking the individual to elaborate on a different theme. Individuals described reflection on teaching practice as well as reflection on a PD program experience. Michael and Joyce were the two teachers that mentioned it, and Joyce mentioned reflection in both round of interviews. Both administrators brought up the idea of reflection during their interviews.

All of the individuals that discussed reflection did so in the context of reflecting on teaching practice, and in a positive way. Michael, the teacher in the gifted program, described a positive aspect of districtwide discretionary time as “It gives you time to...look at what you’re doing currently and reflect on what you might need to change to help get, deliver better instruction for kids.” Here, he is describing a link between discretionary time, reflection, and self-efficacy. Nicole, the experienced physics teacher, mentioned reflection in the context of the benefits of a self-directed PD program she had taken on the DOE website. She describes that the content of the program was “very weak,” but it “forced” her to “be reflective...and that in itself is good.” Robert, the principal, mentioned that reflection is helpful, but that there is “not a real strong reflection

piece usually to the professional development.” Dave, the department chair, also said that reflection is “something that we don’t do enough of” during PD. These individuals all appear to agree that reflection is an important part of teaching that can be provided during PD, but do not have enough opportunities.

Additionally, Nicole mentioned the importance of reflecting on a PD program. She said, “In reflection, I can see that there were more opportunities this year to be autonomous, but as I was in the session, I wasn’t thinking anything about that.” She may have been suggesting that she only realized a PD program helped improve her sense of professional autonomy in reflection after the program.

Lastly, Dave said that there is also an advantage to administrators reflecting on PD, just as teachers are expected to reflect on their instruction, but it is not done routinely. He said, “Certainly, I think sometimes maybe we don’t reflect on PD like we do with teaching.”

4.6.3 Accessibility of Programs Outside the District

One pattern that became clear is that teachers and administrators disagree about the accessibility of some programs outside the district. Nicole, the experienced physics teacher, was the only teacher that mentioned PD opportunities outside of the district without prompting, when asked about PD experiences that were especially helpful. Dave, the department chair, also mentioned these programs outside of the formal interview, which is why I chose to include a question in the interview about these opportunities.

Nicole and Michael were the only teachers that mentioned participating in PD programs outside of the district and gave different reasons for doing so. Nicole took a graduate course on her own, and suggested many teachers don’t participate in graduate courses because “the school

doesn't pay for them or anything. We don't have any, uh, motivation in that way. But like on our pay scale, we get a very small raise, very small.” Michael, the teacher in the gifted program, had attended a conference, but only because of his previous position as an instructional. He said, “the district does not necessarily have, for a majority of the teachers, a mechanism to get them out and into conferences and, uh, PD sessions that aren't just in-house stuff.” According to Michael, the only teachers who can attend these programs are department chairs or “lead learners,” who can “amplify” what they’ve learned by sharing with other teachers in the district. He added on,

it's not, it's not easy for someone to get approval to go to a conference unless of course you want to use your own personal days or take them unpaid or pay for your own travel or, um, all of this stuff. Uh, which basically if you want to take a vacation and go to a conference, you can take a vacation and go to a conference.

Angela said that she did not attend any because it was her first year in the district and she “really didn’t have any time outside of school.”

The administrators seemed to have different views on why teachers may or may not attend PD programs outside of school. Robert, the principal, said that any teacher could complete an application to attend an outside program, but “And then I think other ones just choose not to, you know, they may just read themselves or the are not maybe motivated.” Dave, the science department chair, said that teachers might not want to attend outside PD programs because they are busy outside school and want to stick to the normal teaching routine.

5.0 Discussion

Teachers in the science department in the district in which the inquiry occurred expressed multiple ways their professional development experiences improved their beliefs of self-efficacy and collective efficacy, as well as their perceptions of professional autonomy. While it is likely that the high retention rate in this district is related to many factors in addition to professional development (Ingersoll & Perda, 2010; Podolsky et al., 2016), especially those often correlated with the demographics of the student population (Kokka, 2016), professional development may also have contributed. On the other hand, if teachers had shared that their PD opportunities did *not* support their beliefs of efficacy and perceptions of autonomy, it may have been evidence that teachers remained despite PD, rather than because of it.

Improved self-efficacy could improve job satisfaction and retention (Bogler & Somech, 2004; Cullis, 2009). The same can be said for professional development and professional autonomy, which has a greater body of research linking it to retention (Ingersoll & May, 2012; Ingersoll & Perda, 2010; Pearson & Moomaw, 2005; Wronowski, 2018). This may be important information for school districts wishing to avoid turnover, especially in content areas with greater hiring difficulties, such as science (Ingersoll & Perda, 2010). This also supports the logic diagram in Figure 1, described in Chapter 1. If teachers are improving their beliefs of self-efficacy and perceptions of autonomy through PD, then PD can be positively impacting their retention.

This chapter will include a discussion of the major patterns that emerged from the data, as well as how these patterns are supported by the literature. I will discuss the impact of PD on self-efficacy, collective efficacy, and professional autonomy, as well as teachers' thoughts on

collaboration and reflection. I will also present the limitations of this inquiry, along with implications for practice and future research.

5.1 Teachers Beliefs of Efficacy and Perceptions of Autonomy

This section will present patterns in how teachers and administrators discussed teachers' beliefs of efficacy and perceptions of autonomy. Each of these themes will be discussed in conjunction with the literature. In the process of data analysis, additional patterns appeared to emerge from the data as well. The most prevalent emergent themes related to collaboration, reflection, and agreement between teachers and administrators. I will also draw from the literature to support my results relating to these additional themes.

5.1.1 Importance of Teachers' Beliefs of Efficacy

Although my research involved interviews of a small number of teachers and administrators, every single one of them described ways that PD improved teachers' beliefs of self-efficacy. Additionally, every individual interviewed cited specific examples of PD programs at the district within the last year that had this impact. The way PD can improve self-efficacy most commonly cited by the teachers in my study is that teachers can learn specific new ideas or strategies to implement in their classroom. All interviewed individuals also gave examples of PD that supported collective efficacy because it supported their self-efficacy and because they saw many teachers participating.

Multiple scholars suggest that PD should be designed to support teachers' beliefs of efficacy (Hopkins, 2018; Knowles, 2017; Lumpe et al., 2014). Although I was unable to find research demonstrating which characteristics of professional development can contribute to teachers' beliefs of efficacy, there were many suggestions about what makes PD high quality, including relevance, follow-up, and opportunities to learn from other teachers (Knowles, 2017; Lumpe et al. 2014). All individuals I interviewed addressed relevance by discussing how PD gave them new ideas for their own classroom, helped them learn more about their role, or learned more about their students. While nobody mentioned positive examples of programs in the district that included sufficient follow-up, several individuals said that PD does not improve self-efficacy if there is no follow-up where teachers could share their results from new strategies and continue to discuss the topics originally presented in PD. Lastly, nearly all individuals interviewed gave examples of PD that improved their collective efficacy by allowing them to learn from other teachers.

As a result of improved self-efficacy, teachers can respond to setbacks differently (Bandura, 2012) and feel more confident in the classroom (Beebe, 2013), both of which can improve job satisfaction and retention. There may also be a direct link between collective efficacy and job satisfaction (Beebe, 2013; Bogler & Somech, 2004). In this way, PD programs that improve teachers' beliefs of efficacy in the ways described by the study participants may also have a positive impact on retention.

5.1.2 Importance of Teachers' Perceptions of Professional Autonomy

Although there was less agreement on which aspects of PD and which specific programs improved teachers' perceptions of professional autonomy, every individual described ways that

PD could improve professional autonomy. Most individuals interviewed cited the Technology Program as a specific example of a program in the district that improved their perception of professional autonomy because it provided teachers with many options for instruction that they could choose. Both teachers and administrators suggested fewer was PD impacts professional autonomy and were more likely to agree on these ideas than about ideas on efficacy. This may be a reflection of the many other factors in a teaching position that impact perceptions of professional autonomy.

Scholars have suggested that high quality PD can improve teachers' perceptions of professional autonomy (Covay Minor et al., 2015; Hyslop-Margison & Sears 2000; Wronowski, 2018), although disagree what "high quality" may mean. Hsylop-Margison and Sears (2000), as well as Kennedy (2005), suggest that teachers should engage critically with traditional classroom practices during PD, rather than being taught to maintain the status quo. They argue that PD should allow teachers to contribute to processes at the schoolwide and districtwide levels in order to be meaningful to teachers. Teachers should be examining and revising current teaching practices during PD, rather than only transmitting knowledge from more experienced to less experienced teachers. This would encourage teachers to develop a sense of professional autonomy.

Bredeson (2000) suggests that administrators should allow teachers to have some ownership and independence in their learning. Most of the teachers and administrators interviewed agreed that teachers taking ownership of PD can improve teachers' perceptions of professional autonomy. Several of them gave specific examples of programs they had attended, including the Technology Program and self-directed PD opportunities, that allowed teachers to take ownership of the content or nature of their learning in PD. Additionally, Dave, whose role is part administrator

and part classroom teacher, mentioned that the PLC helped his own perception of professional autonomy by allowing him to contribute to the program himself.

Conversely, most of the study participants' thoughts related to teachers' perceptions of professional autonomy only within their own classroom, rather than within the PD program. This included ways that PD positively and negatively impacted teachers' perceptions of professional autonomy. This difference between my results and literature could be a novel observation, or a result of limitations in my interview or analysis protocols.

Professional autonomy may also correlate to teacher retention. Not only have many scholars described a link between professional autonomy and teacher retention (Ingersoll & May, 2012; Ingersoll & Perda, 2010; Wronowski, 2018), but Pearson and Moomaw (2005) suggest that teachers most often leave the classroom due to a lack of professional autonomy. There is also a link between professional autonomy and job satisfaction (Pearson & Moomaw, 2005). As a result, PD that positively impacts teachers' perceptions of professional autonomy in the ways described by the study participants may also positively impact retention.

5.1.3 Collaboration

Collaboration was described as important by many of the individuals interviewed. It was often discussed along with self-efficacy and collective efficacy. The literature supports this link between collaboration and teacher efficacy. Raudenbush, Rowan, and Cheong (1992) demonstrated a positive correlation between collaboration and self-efficacy. They surveyed teachers across 16 schools and found that teachers who reported working in a collaborative environment were more likely to have higher levels of self-efficacy. Similarly, although Guo et al. (2011) were studying preschool teachers, they found that teachers with a greater sense of

collaboration in their schools were more likely to have higher self-efficacy. My results further support Raudenbush et al.'s and Guo et al.'s conclusion that collaboration can have a positive impact on self-efficacy. Similarly, since self-efficacy and collective efficacy were often linked together by the individuals I interviewed, it is unsurprising that collaboration was linked to collective efficacy as well.

In addition, in their 2008 meta-analysis of 34 studies, Borman and Dowling described a link between collaboration and teacher retention. They found that collaboration, including common planning time with other teachers in the same subject area, were predictors of teacher retention. They summarized research correlating opportunities for collaboration with a lower attrition rate. They also make the suggestion that collaboration can be addressed to improve teacher retention because collaboration can be facilitated relatively easily.

5.1.4 Reflection

Several individuals who were interviewed described reflection as important for improved self-efficacy. This included both reflection on one's own teaching practice, as well as reflection on the goals and outcomes of a particular PD program. Yost (2006) suggests that reflection can help teachers overcome challenges, especially within the first few years of teaching. This is when teacher turnover is the highest, which is why Yost argues that reflection should be encouraged to improve retention. Avalos (2011), in summarizing research on professional development between 2000 and 2010, discussed reflection several times in the context of professional development. She provides evidence that reflection during professional development can be used to encourage change in a teacher's practice.

Additionally, there were occasions in the interviews when an administrator mentioned the purpose of a program, and the teachers did not; reflection could offer an opportunity for teachers to uncover the purpose of the programs. Nicole, the experienced physics teacher, even mentioned this idea specifically, when explaining that she did not see at the time how a program improved her perception of autonomy, but did upon further reflection. I also found that, over the course of the inquiry, I was began reflecting on the benefits of my own personal PD experiences, which I had not considered prior to this reflection. Based on the literature and my results, it appears that reflection can be a useful tool for improving self-efficacy both in the context of a teacher's own practice and within professional development.

5.1.5 Agreement Between Teachers and Administrators

Overall, there was quite a bit of agreement between teachers and administrators. There was no disagreement between the two groups for any of the categories of PD available to science teachers, except for the accessibility of programs outside the district. They agreed on all districtwide, schoolwide, and departmentwide PD programs available and many of the characteristics as well. Teachers were more likely to say that paperwork and cost of programs outside the district were prohibitive, whereas administrators were more likely to say that attendance of these programs was dependent on the teachers' interest and time commitment.

Additionally, nearly all of the reasons listed that PD impacts self-efficacy, collective efficacy, and autonomy, that were agreed upon by multiple individuals, had agreement between teachers and administrators. In the few cases where an idea was suggested by multiple teachers but not an administrator, the administrators were not specifically asked about that opportunity.

Dave, the science department chair, was more likely to suggest an idea in common with teachers than Robert, the principal.

In my experience, teachers often complain about available PD opportunities, and I heard similar responses from the teachers I interviewed. Scholars suggest that this “pessimistic” attitude of teachers may make it difficult for them to change their practice with strategies they have learned from PD (Finn, Swezey, & Warren, 2010). However, when asked about specific characteristics of PD, such as a program’s impact on self-efficacy, both teachers and administrators had positive comments on almost all of the programs discussed. This may relate to the idea of reflection described above, as teachers’ opinions of PD appeared different when asked to reflect on specific aspects of a program.

Lastly, Angela, the new teacher, had the highest percentage of positive statements about PD, both by itself and compared to her previous position. In my experience, a newer teacher may be less pessimistic about PD because new strategies can be presented many times over several years, with little evidence to show their effectiveness. After several years in the same position, a teacher may be exposed to the same ideas over and over again.

5.2 Limitations of Study

This investigation had several weaknesses that may impact the overall validity of its findings. The nature of my study limited its scope to a very small sample. A sample of four teachers is small and represents less than 10% of the teachers in the science department. Although the teachers taught across science content areas, I cannot assume they are representative of the entire

department. Also, my sample was one of convenience, and included only one teacher with few years of experience.

The findings within one school district cannot necessarily be generalized to other districts, especially since the school district in the study falls at one end of the demographic spectrum. This district is has more resources for students and teachers than many other districts, so a similar inquiry in a different district may have different results.

The study was also conducted over a small time frame, so did not allow for any long-term follow-up. Several interviewed individuals mentioned anticipated changes in the district's PD planning, so the data collected in the inquiry may be outdated even as soon as next year. Additionally, I did not attempt to measure efficacy, so did not know teachers' levels of efficacy. As a result, conclusions were drawn from teachers' own thoughts on the effects of these programs, rather than measured effects.

Although the impacts of this study may be limited, there is room for conclusions for this department in this school district.

5.3 Implications

The literature draws a connection between professional development and self-efficacy, collective efficacy, and professional autonomy. The findings of this study include certain PD practices that support the development of science teachers' beliefs of efficacy and autonomy. Although there are limitations to the study, it provides a snapshot of the PD opportunities available to science teachers in one district, according to some teachers and administrators in that district. This section will present the study's implications for practice and for further research.

5.3.1 Implications for Practice

The district has a reputation for high quality instruction and low teacher turnover, which have many causes other than PD, but can still provide insight into factors that may have contributed to the district's success. Overall, the teachers and administrators showed more agreement than expected, and stated more positive impacts than negative or neutral impacts about the PD opportunities. My findings may be useful for administrators within this district to see what is working well for teachers, as well as where teachers want more support from PD for their beliefs of efficacy and perceptions of autonomy. They may also be useful for administrators in similar districts to see what might work in PD programming, and even for districts with dissimilar demographics but are interested in improving teachers' beliefs of efficacy and perceptions of autonomy through PD. Although my personal teaching experience has been almost entirely in districts with very different demographics from this one, the teachers' and administrators' statements were similar to ones I have heard and would expect to hear in the districts where I have taught.

The data indicated that PD can improve teachers' self-efficacy if teachers learn specific new ideas that they can implement in the classroom and if teachers can learn more about their role and expectations of them, although I was unable to find evidence to support or detract from this idea in the literature. PD also may improve self-efficacy if teachers can learn more about their students, reflect on their practice, or learn how to better prepare their students for the future. The literature does support a link between teacher reflection and self-efficacy (Ogbomo, 2002; Yost, 2006). Teachers and administrators both expressed that PD can support teachers' collective efficacy by building their self-efficacy, above all, but also by having teachers see what other teachers are doing in their classrooms, see other teachers implementing what they learned in PD,

and having opportunities to develop curriculum and instructional materials with other teachers in their same content area. Since teachers indicated that improved self-efficacy within a group can help improve collective efficacy, it may not be necessary for PD to address collective efficacy directly. PD can also improve teachers' perceptions of professional autonomy by offering choices of instructional strategies that teachers could choose how to implement, and by allowing teachers to direct the topic and depth of the PD program. Lastly, opportunities for reflection and collaboration can also have positive impacts on teachers' beliefs of efficacy and autonomy.

In my experience, many PD opportunities offered to science teachers include many of these aspects, but they are not always prominent. Teachers suggested that emphasizing these aspects of PD, either by encouraging teachers to reflect on the program or by more clearly presenting the purpose of the program, can improve teachers' beliefs of efficacy and autonomy with very little change to the PD program. Similarly, adding opportunities for teachers to learn more about their roles, learn more about their students, reflect on their practice, or learn how to better prepare students for the may require more time or a different allotment of time, but can also improve teachers' beliefs of efficacy and autonomy.

Personally, I have learned more about the nature of the link between PD and self-efficacy, collective efficacy, and professional autonomy. As my career progresses, I hope to find myself more in a position to help develop PD programs or provide input on others' PD programs. I plan to use what I know to help develop PD programs that are more likely to improve teachers' beliefs of self-efficacy, collective efficacy, and professional autonomy, with minimal added time to the PD programs. As a result, I hope these changes will also have a positive impact on teacher retention in the schools where they are implemented.

5.3.2 Implications for Future Research

Although this inquiry provided insight into the link between professional development and teachers' beliefs of efficacy and autonomy, it was limited to a small subset of science teachers at one district at one time. Thus, it could be beneficial to investigate these connections on a larger scale, and speak with more science teachers at this school and continue investigating them over multiple years or even across an entire school year. It would be interesting to see how their thoughts changed over several years, as their careers progressed, as well as following teachers who left their positions. Teachers who have left their positions might have useful insight into how PD opportunities impacted their decision to leave. Additionally, researchers could look at other content areas that have hiring difficulties, such as special education (Ingersoll & Perda, 2010).

Additionally, it could be beneficial to further explore the links between PD, efficacy, autonomy, and retention. There is room for further exploration into the ways PD can impact teachers' beliefs of efficacy and autonomy. I was also unable, given the constraints of my inquiry, to investigate the direct link between these factors and teacher retention. Finding out more about how these factors can impact retention, and how PD can impact these factors, can be helpful for schools struggling with turnover.

Appendix A Pre-Interview Demographics Survey

1. Where did you receive your undergraduate education?
2. What undergraduate degree do you have and in what subject?
3. What additional majors or minors did you have?
4. What graduate degrees do you have, if any, and where did you receive them?
5. Where did you attend your teacher training program, if not mentioned above?
6. What teacher certification(s) do you have currently?
7. What grades and subject areas do you work with on a daily basis?
8. How long have you been teaching here, including this year?
1 year 2-5 years 6-10 years 11+ years
9. What are your responsibilities at work? (Circle all that apply)
Full-time classroom teacher Part-time classroom teacher Teacher mentor
Department chair Building administrator Other _____
10. How long have you been working in education, including this year?
1 year 2-3 years 4-10 years 11+ years
11. Would you be interested in participating in my research? It would involve a group interview and two individual interviews over the next few weeks.
Definitely interested
Maybe interested
Not interested
12. If you are interested or maybe interested in participating, how can I best contact you?
Call: _____
Text: _____
Email: _____

Appendix B Group Interview Protocols

1. What was the most important learning or insight you gained from the professional development session on March 29?
 - a. How do you think today's program compared to other ones you've participated in this year?
 - i. **Do you think it was more or less applicable to your classroom teaching?**
 1. **How do you think it will impact how well you teach science? Why?**
 2. **How do you think it will impact how effective the science department is?**
 3. **How do you think it will impact how much you are able to make your own decisions in your classroom?**
 - ii. **(If I notice a connection or disagreement between what different teachers have said, especially relating to self-efficacy or collective efficacy, try to prompt discussion, such as: Teacher A said this, what do you, Teacher B, think about that, since it seems different from what you said?)**
2. Which professional development opportunities were available to you this year?
 - a. Which of these did you attend?
 - b. Which were available to non-science teachers?
 - c. **Which were you most able to apply to your classroom teaching? Why?**
 - i. **Which helped you be most effective?**
 - d. **Which helped the science department be most effective? Why?**
 - e. **Which supported your ability to feel in control of your teaching practice?**
 - f. If you could add a PD, what would it be? Why?
3. Is there anything else you would like to add?

Appendix C Interview Protocols for Teachers, First Interview

- Agenda:
 - Question 1 - 2-5 min
 - Question 2 - 2-5 min
 - Question 3 - 5-10 min
 - Question 4 - 5-10 min
 - Question 5 - 5-10 min
 - Questions 6-9 - 5-10 min
 - Aim for 30 minutes, but leave extra time in case teacher wants to share more.
 - Question 1 is designed to start a discussion, but there is no specific information I need to get out of it.
 - Questions 2-4 are the primary focus of the interview. Probing questions are designed to encourage or steer discussion towards PD's impacts on efficacy, but do not need to be asked if the teacher addresses the ideas anyway.
1. Do you have any additional thoughts about the PD session you didn't get to share during the group interview?
 - a. What do you think the goal of the March 29 PD was?
 - i. Do you think it met its goal? How did it do that?
 2. How did the PD impact your ability to provide good instruction?
 - a. In the group interview, you/someone mentioned the March 29 keynote speaker and student presentations. What do you think about those?
 - b. How did the program affect how effectively you teach science?
 3. How did the PD impact your school's ability to provide good instruction?
 - a. Do you think it had or will have a positive impact on other students? How?
 - b. Do you think it will impact students otherwise?
 4. Autonomy was mentioned in the group interview. Do you think the PD impacted how much autonomy you feel you have in your classroom?
 5. Which PDs you attended this year were most helpful in your classroom?
 - a. As a science teacher?
 - b. Most impactful on the school as a whole?
 - c. Most helpful for any other teachers?
 - d. Most helpful for feeling control of your teaching practice?
 - e. How do your feelings differ between district, building, and department PD?
 - f. Your colleagues mentioned districtwide, buildingwide, and departmentwide PD. How do you feel differently about each of those?
 - g. Your colleagues mentioned PLC. What do you think about those?
 6. You mentioned you attended _____/Your colleague attended _____, why did you attend those and not others?
 - a. Were there any PD opportunities you wanted to attend but didn't? Why?
 - b. Are there any other programs you would like to see? Why?
 - c. How might they impact you?

- d. How do you feel your own personal needs and interests were taken into account when PD opportunities were determined?
 - e. How do you feel you are encouraged to seek PD and education outside of here?
 - f. How would you answer these questions differently if it were your first year teaching?
7. Have you ever worked in a different district? How do you think the PD opportunities compare?
 8. If teacher states role in addition to or other than full-time teacher, ask: "You mentioned you're a teacher mentor, what does that mean?" How does it work with classroom responsibilities?
 9. Is there anything else you would like to add?

Appendix D Interview Protocols for Administrators, First Interview

(For science department chair, ask him to answer both as a teacher and as an administrator)

1. What was the intended purpose of this PD program?
 - a. How well do you think it achieved its purpose? Why?
 - b. [If they didn't choose the program] Would you have chosen this program? Why?
2. How did the PD impact the teachers' ability to provide good instruction?
 - a. How did the program affect how effectively they teach science?
 - b. How did the program affect how much science your students are learning?
 - c. Teachers said " " (several examples relating to efficacy or autonomy). Is that something that represents a goal of PD?
 - i. Can you talk more about that?
 - ii. How would you characterize the impact it had on the teacher?
 - iii. How important is that when you make decisions about PD opportunities?
 - d. Who chose this program? Why?
3. How did the program affect how well teachers are able to make decisions in their teaching practice?
 - a. In terms of autonomy in their classroom?
4. How did the PD impact your school's ability to provide good instruction?
 - a. Do you think it had a positive impact on other students? How?
 - b. Or impact students otherwise?
 - c. Teachers said " " (relating to collective efficacy). What do you think about that?
5. What PD opportunities did science teachers have this year?
 - a. Which did they participate in?
 - b. Do they have opportunities to participate in programs outside the district?
 - c. Why do you think they participated in those and not others?
 - d. Which of the programs they participated in did you consider the most effective professional development for science teachers? Why?
 - e. Are there any professional development opportunities you would like to see? Why?
 - f. How do you decide on PD programming?
 - g. How do you think NA's PD opportunities compare to other schools' PD opportunities?
6. Is there anything else you would like to add?

Appendix E Protocols: Observations During PD Program

- Look for mention of self-efficacy, collective efficacy, professional autonomy
- Ability to make kids learn science
- Ability of school to make kids learn
- Ability for teachers to make own choices in the classroom
- Suggesting multiple strategies and encouraging teachers to choose
- Look for mention of qualities teachers mentioned in interviews as helpful to them in their classroom (Answers to question #5 in individual teacher interviews)
- Look for times when teachers start writing/taking notes
- Look for times when teachers are talking to each other (productively or off-task)

Appendix F Protocols: Follow-Up Interview for Teachers

1. Do you have any additional thoughts about the March PD session you didn't get to share during the first interviews?
 - a. Were you able to implement what you learned in your classroom?
 - b. Why did you or didn't you implement in your classroom?
2. How do you think the May PD compared to the March PD?
 - a. What do you think the purpose of sessions like the May PD is?
 - b. Do you think it makes you more effective in the classroom? Do you think it makes your school more effective? Do you think it affects your sense of autonomy?
 - c. Which had more of an impact on your classroom? Why?
 - d. The department chair shared the results of a survey that asked what you wanted to see in PD next year. What do you think about that?
 - e. The department chair mentioned he gets constant requests for more collaboration time. Why do you think this is?
 - f. In the afternoon, teachers shared out some ideas of things they had tried this year that worked for them. What do you think about this part?
 - g. Can you describe what you were working on during the unstructured time in the afternoon?
3. Overall, which PD you had this year had the most impact on your ability to provide good instruction?
4. Overall, which PD you had this year had the most impact on your school's ability to provide good instruction?
5. Overall, which PD you had this year had the most impact on how you feel in control of your teaching practice?
6. Is there something about a PD that affects whether you implement the strategies in your classroom?
7. Is there anything else you would like to add?

Appendix G Protocols: Follow-Up Interview for Administrators

1. Do you have any additional thoughts about the March PD session you didn't get to share during the first interview?
 - a. Were teachers able to implement what you learned in their classrooms?
 - b. Why did you think they did or didn't implement it in their classrooms?
2. How do you think the May PD compared to the March PD?
 - a. Which had more of an impact on how your teachers feel about their effectiveness at teaching science?
 - b. Which had more of an impact on how your teacher's feel about the school's ability to provide good instruction?
 - c. Which had more of an impact on how teachers feel in control of their teaching practice?
3. Were the reasons for the school providing the May PD similar or different from the March PD? Why?
4. Is there anything else you would like to add?

Appendix H Data Tables

Table 1. Ways professional development improves self-efficacy.

Idea, as mentioned by teacher or administrator	Teachers Who Mentioned (4 total)	Administrators Who Mentioned (2 total)
PD improves self-efficacy because		
Teachers learn specific new ideas or strategies they can implement in my own classroom	4	2
It helps teachers learn more about their role and expectations of them	3	2
It helps teachers learn more about their students	3	1
It allows or encourages teachers to take time to reflect on their practice	2	2
It helps teachers better prepare students for the future	2	2
Teachers are motivated to learn how to better their practice from it	2	1
Teachers know they are required to do something that everyone else is doing too	1	2
It makes teachers feel comfortable taking risks or inspired to try something new	1	2
Teachers can take time to adapt my instruction to their specific students	1	
Having an extra observer in the classroom helps teachers see additional things	1	
It reinforces or validates what teachers already know	1	
New initiatives are presented in a way that makes them seem positive	1	

Table 2. Ways professional development does not improve self-efficacy.

Idea, as mentioned by teacher or administrator	Number of Teachers Who Mentioned (2 total)	Number of Administrators Who Mentioned (2 total)
PD does not improve self-efficacy because		
Teachers didn't learn anything they could implement in their classroom	3	1
Teachers are told to do something or told it will be effective; they need to see evidence it works	2	1
There is no follow up where teachers could share how it went and continue to discuss it	1	2
It has too much information to absorb at the time	1	0

Table 3. Ways professional development improves collective efficacy.

Idea, as mentioned by teacher or administrator	Teachers Who Mentioned (4 total)	Administrators Who Mentioned (2 total)
PD improves collective efficacy because		
It makes teachers more effective, and they assume the other teachers in the same program are becoming more effective as well (Includes all ways PD impacts self-efficacy)	4	2
Teachers got to see or learn about what other teachers are doing in their classrooms	3	2
Teachers see other teachers implementing what they learned in PD	3	2
Teachers can develop curriculum and instructional materials with other teachers in their content area	3	2
Teachers need to learn district and building procedures	2	2
Teachers get to help and share ideas with other teachers	3	0
Teachers can address organizational and safety concerns across the science department	2	0
Teachers are building relationships and collegiality as colleagues	1	0
All teachers are learning the same thing	1	0
Teachers heard someone outside the school recognize the things our district is doing	0	1

Table 4. Ways professional development does not improve collective efficacy.

Idea, as mentioned by teacher or administrator	Number of Teachers Who Mentioned (2 total)	Number of Administrators Who Mentioned (2 total)
PD does not improve collective efficacy because		
Some other teachers might appear to not be improving their practice	2	2
Teachers did not see an end goal or result for their department, school, or district	2	1
It does not improve efficacy of other teachers	2	0
Many teachers do not have opportunities to attend PD outside of the district	1	1
If teachers are allowed to choose what they want to learn, they will not necessarily pick the right things	1	0

Table 5. Ways professional development improves perceptions of professional autonomy.

Idea, as mentioned by teacher or administrator	Teachers Who Mentioned (4 total)	Administrators Who Mentioned (2 total)
PD improves teachers' perception of professional autonomy because		
Teachers were given a choice of ideas and strategies, and could implement them when and how they wanted	3	2
Teachers could direct the topic and depth of learning at PD (whether as input on a formal program or flexible work time)	3	2
Teachers were given time work on customizing instruction in their classroom	2	1
Teachers could take the ideas and strategies from the program and customize them in their classroom	1	2
Teachers had structured freedom to deliver instruction the way they choose, as long as it fits within the curriculum and standards	1	2
Teachers were able to contribute to the program	0	1

Table 6. Ways professional development decreases perception of professional autonomy

Idea, as mentioned by teacher or administrator	Number of Teachers Who Mentioned (2 total)	Number of Administrators Who Mentioned (2 total)
PD decreases teachers' perception of professional autonomy because		
Teachers were given specific rules to follow	3	2
Teachers were working on common assessments	1	0

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