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IMPROVING THREE-DIMENSIONAL INSTRUCTIONAL PRACTICES VIA PROFESSIONAL DEVELOPMENT

Alethea Henry

IMPROVING THREE-DIMENSIONAL INSTRUCTIONAL PRACTICES VIA

PROFESSIONAL DEVELOPMENT

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by

ALETHEA N. HENRY

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ABSTRACT

The purpose of this applied research study was to improve the use of three-dimensional pedagogy in science classes in chronically low-performing schools. The need to build teacher capacity became evident after the state adopted more rigorous science standards revealing deficits in teachers' pedagogical content knowledge. This study utilized two elements, three-dimensional professional development and the science cadre, to build teacher capacity as well as foster collaboration and create buy-in throughout the district among science leaders. Data collected and analyzed from classroom observations, student surveys, and teacher interviews revealed improved usage of three-dimensional instruction and increased buy-in throughout the district to implement three-dimensional instructional practices.

DEDICATION

To my father, James Stone, from whom I inherited my thirst for knowledge and love of academia. Rest in love.

To my grandmothers, Manervia Givens and Agnes Walker, for providing examples of feminine strength. I know you are both watching!

And last but not least...To my AMAZING mother, Mary E. Jackson, for raising me to believe I could do and be anything I wanted. We did it!

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CHAPTER I

INTRODUCTION

Statement of the Problem

The U.S. Department of Labor reports the number of STEM jobs will increase by 8.8% by 2028 (U.S. Bureau of Labor Statistics, 2018). To prepare for the increase in demand, the US Department of Education developed a five-year strategic plan in 2018 for STEM education with goals to build strong foundations for STEM literacy, increase diversity, equity, and inclusion in STEM, and prepare the STEM workforce for the future. However, results from the most recent study in a series of six conducted over the last five decades indicated students in grades K-3 are only receiving 18 minutes of science instruction per day compared to 57 in math and 89 in reading/language arts. In grades 4-6, students are receiving 27 minutes per day compared to 63 in math and 82 in reading/language arts (Banilower, Smith, Malzahn, Plumley, Gordon, & Hayes, 2018). High school students in most of the 50 states need fewer science course credits to graduate than in English and mathematics as evidenced in the *50 State Comparison* (Education Commission of the States, 2019). Limited instructional time and increasing societal demands demonstrates a critical need for effective and efficient science instruction.

Even though science has not been prioritized in schools as other content in terms of instructional minutes, national science education reform challenges traditional pedagogical methods in hopes of better preparing students to work in an ever technologically advancing society, the most recent organized by the National Research Council in the development of *A Framework for K-12 Science Education* which subsequently led to the creation of the Next

Generation Science Standards (NGSS). The framework is built on the premise science instruction should be three-dimensional. Students must engage in the science and engineering practices and utilize the cross-cutting concepts to develop their understanding of disciplinary core ideas while making sense of natural phenomena as scientists do in the real world (2012). NGSS have been adopted by 20 states and the District of Columbia. Twenty-four other states have utilized the framework to create their own standards including Tennessee.

Tennessee adopted new three-dimensional science standards in 2016: however, implementation and internalization has been a slow process in the Turnaround School District even though teachers have engaged in various professional learning opportunities over the last three years. Garet, Porter, Desimone, Birman, and Yoon (2001) revealed sustained, content-focused, and coherent professional development (PD) is more likely to impact teacher outcomes. The study also revealed types of PD, whether traditional (workshops and conferences) or reform (study groups and networks), indirectly affect teacher outcomes through the other PD core features of collective participation and duration. Because reform PD typically spanned longer and required more collective participation than traditional PD, reform PD exhibited more positive outcomes. Yoon, Garet, Birman, and Jacobson (2007) were able to substantiate the findings with the exception of collective participation in a follow-up study a few years later. Video analyses revealed changes in instructional practices of teachers who had received scaffolded PD by an expert (Kleickmann, Tröbst, Jonen, Vehmeyer, & Möller, 2016). Teachers in the experimental group addressed student conceptions more intensely and structured the content more strategically than the control group.

While some studies have shown a positive impact of PD on teacher practice, fewer have shown any effects on student achievement. Yoon, Duncan, Lee, Scarloss, and Shapley (2007) in their review of research found teachers who received an average of 49 hours of sustained PD can increase student achievement. However, this study was only able to include data from nine studies after vetting 1300 according to What Works Clearinghouse standards. Johnson and Fargo (2010) reported a positive effect on student achievement when teachers had participated in whole-school, sustained, collaborative PD, and scaffolded PD by an expert increased student achievement (Kleickmann et al., 2016).

Many of these studies examining science instruction were specifically performed prior to the development of *A Framework for K-12 Education*. Therefore, there is limited inquiry regarding the employment of three-dimensional pedagogy and its effects on teacher outcomes and student achievement. This mixed-methods study seeks to add to the existing research by exploring the relationship between reform PD and the transferability of three-dimensional instructional practices.

Description

The Turnaround School District is a portfolio district comprised of 26 schools managed by various charter organizations, and three schools managed directly by the district: five high schools, 10 middle schools, and 14 elementary schools. The district's existence is a result of the state of Tennessee's efforts to better serve historically low-performing schools having consistently fallen in the bottom five percent of schools across the state. While I do support the entire district, much of my more intense work occurs in the three elementary schools directly operated by the district because many of the charter organizations view the district as an authorizer only. However, this perception is gradually changing as evidenced by the increasing number of charter participants in professional learning provided by the district.

The district-operated (DO) schools are located in one of the most impoverished zip codes in the state of Tennessee. They service approximately 1000, K-5 students with over 95% of the students receiving free or reduced lunch. On average these schools lose about 50% of their faculty per year, and teacher experience averages less than three years. Teachers of grades K-2 only teach science as it appears in the reading/language arts curriculum as principals have chosen not to allot an instructional block for science due to limited instructional minutes, lack of experienced personnel, student deficits in literacy and numeracy, and minimal emphasis placed on science by the state. Between the three schools, there are nine science teachers total for grades 3-5, and six of them teach math also.

In 2015, the last year science data was calculated in the Turnaround School District's success rate, the district received an F in 3-8 science. This grade was based on assessments of standards that were skill-based only requiring students to memorize isolated facts. To my delight, the state adopted new science standards the following year. However, the implementation process has proven quite overwhelming for teachers similar to the way it was a few years prior when the state adopted Common Core standards in reading/language arts and math. Even though the new science standards were adopted in 2016, teachers are still struggling to make the instructional switch mentally and literally in part because students were not scheduled to be assessed on those standards until 2020, and the new standards have created an extensive content and pedagogical learning curve for teachers and students. The new standards were developed using *A Framework for K-12 Science Education*. The standards necessitate teachers create learning opportunities for students to integrate the three dimensions (science and engineering practices, cross-cutting concepts, and disciplinary core ideas) to promote sense-making of the content.

Since 2018, science teachers in the DO schools have participated in monthly and semi-monthly professional learning which included such topics as three-dimensional instruction, phenomena-driven instruction, and standards deep dives to increase teachers' knowledge of the standards and ultimately, the students' scientific literacy. After each professional learning experience, teachers complete a survey in which they express their overall satisfaction. All surveys are anonymous, and the satisfaction rate is always over 90%. However, there is a disconnect between teacher satisfaction with professional development and improvement of practice as indicated during classroom observations. Teachers are not applying professional learning to classroom practice. This applied research study will provide insight as to how to increase the use of three-dimensional instructional practices in science classrooms. These practices move students past memorization of facts and allow them to make sense of natural phenomena through inquiry and discovery as scientists do. I view this study as a unique opportunity to engage students by capitalizing on their natural curiosity.

Because science teachers encounter numerous barriers, it is extremely important to ensure a return on time invested in professional learning. After collecting data from teacher interviews, student surveys, and classroom observations, a plan will be developed and executed to increase the employment of three-dimensional instructional practices in the DO schools. While the ultimate desire is for students to acquire new knowledge as determined by test scores, the primary focus of this study is to determine the impact of PD on instructional practices. Therefore, test scores will serve as secondary data to interviews, surveys and classroom observations.

Justification

On average, students in grades three, four, and five receive about 42 minutes of daily science instruction in the three DO schools. However, it is important to note most students are receiving less than 30 minutes while very few actually receive as much as 75 minutes a day. The majority of science teachers in the DO schools teach another core subject forcing them to divide their time between at least two subjects and sometimes three. Since school accountability measures most often focus on achievement in reading and math, other subjects, specifically science, are not prioritized. With the adoption of new standards and limited instructional minutes, the district realizes the need for more effective science instruction.

Science teachers in the DO schools have participated in district-led learning for the last two years. It has been a mixture of traditional and reform types of professional development. In 2018-2019, the district offered five, two-hour workshops throughout the year in addition to the typical week-long standards training provided as part of teacher in-service. The following year, the district offered 10, three-hour sessions as this was the first year students would be assessed on the new standards. Instructional coaching was also provided, but was inconsistent due to several barriers including high rates of attrition and limited time, especially if the teacher taught another subject. After every professional learning experience, teachers completed surveys. The satisfaction rate from the surveys was always over 90%. Nevertheless, classroom observations revealed little change in instructional practice. In 2020, less than five percent of students received passing grades on the science interim assessments given each quarter.

The new standards require instructional shifts which have proven difficult for teachers to make in the DO schools. Instead of students recalling scientific facts, they must now use practices and crosscutting concepts to make sense of natural phenomena. This is challenging, particularly for elementary teachers because they are typically educational generalists without specific science training. In addition, this is probably not the way current science teachers were taught science which provides limited experiences from which to draw. Since research has shown PD can increase student achievement in multiple subjects (Johnson & Fargo, 2010; Klieckmann et al., 2016; Yoon, Duncan, Lee, Scarloss, & Shapley, 2007), this study will help the district determine how to approach PD for science teachers. In 2006, Johnson, Kahle, and Fargo reported students of teachers who received science-specific PD significantly outperformed students of teachers who had not, implying similar programs could be used to decrease science achievement gaps. Heller, Daehler, Wong, Shinohara, and Miratrix (2012) researched the effects of three professional development models on teacher knowledge and student achievement along with delayed effects the following year, specifically in elementary schools. The three PD models included Teaching Cases, Looking at Student Work, and Metacognitive Analysis. Compared to controls, all three models significantly improved student and teacher scores on selected-response science tests ($p>.001$). After participating in 80 hours of science and math professional development, teacher content knowledge increased as indicated by pre and post exams, and fifth-grade students saw some gains on state standardized tests (Buczynski & Hansen, 2010).

Significance

This study can serve as a resource to science coordinators as they can be influential in changing teacher beliefs and practices (Whitmore & Chiu, 2015). Although Whitmore, Maeng, and Bell (2018) examined the practices of science coordinators after they had participated in an academy specifically designed for them, their study did not evaluate the effects of the science coordinators' practices on teachers. However, this study can extend the research because one of its primary foci is teacher outcomes. Science coordinators in this district are responsible for portfolio-wide PD and more intensive types of PD within the DO schools. Examining and revising the approach to PD in the Turnaround School District might be necessary for increased teacher capacity and improved student outcomes.

School leaders in the DO schools can benefit from this study because it will identify barriers and needed supports at the school level affecting teacher outcomes. Since studies have shown collaboration to be a key component of effective PD (Akiba et al., 2019; Doppelt et al., 2009; Johnson, 2006), school leaders can use this study to inform their practices of support for teachers such as developing collaborative structures and systems for planning and PD within schools. Without proper support from school leadership, teachers cannot be expected to enact such changes in instructional practice. Professional development from district level personnel in the Turnaround School District has not been proven successful in part because the support for science teachers does not continue within the school buildings in the absence of the district science leaders. School leaders can stimulate and motivate teachers to implement new learning gained from PD by increasing their own content knowledge, monitoring and evaluating instruction, and providing teachers with feedback (Whitworth & Chiu, 2015).

Science teachers will not only develop an understanding of three-dimensional practices, but they will also develop into a professional learning community who will provide support themselves as they apply these practices in the classroom promoting self-efficacy and teacher agency (Akiba et al., 2019; Carney et al., 2019; Wood, 2007). This can lead to job satisfaction and possibly increase teacher retention (Duyar, Gumus, & Bellibas, 2013).

This study can help inform policy by making the case for increased instructional minutes for science particularly in elementary schools if time continues to be a barrier even when teachers are using the time they do have more effectively. It could also provide some insight for pre-service teacher programs to better prepare elementary teachers for teaching science using three-dimensional practices.

Research Method

The intent of this applied research study is to transform science instruction in the Turnaround School District. The research process will explore the employment of three-dimensional instructional practices in schools and seeks to discover the relationship, if any, it has with PD. Qualitative and quantitative data garnered from interviews, classroom observations, and meeting notes will be compared with quantitative data from attendance records, participation, and surveys to fully examine the factors influencing the transferability of professional learning to classroom practice. A collaborative plan will be developed by various stakeholders, including science coordinators, school leaders, science teachers, science content leads, and instructional coaches, to explore the central phenomenon between September of 2020 and March of 2022.

Purpose

The purpose of this study is to increase and improve the use of 3-D instructional practices via job-embedded PD. If the plan is successful, improved science pedagogy should lead to more scientifically literate students. This action plan will consist of macro and micro approaches to address the problem of practice. The macro strategy will be to establish a science cadre, a community of district science leaders with a mission to transform science education providing opportunities for learners to learn science the way scientists do science. The collaboration between members of the cadre will provide a conduit for the district to affect change in science instruction throughout the entire portfolio of schools. The micro strategy will allow for a more intense focus on 3-D PD as teachers and students within the DO schools will be interviewed and surveyed post program implementation.

District science leaders will collaborate to develop an action plan considering researched-based components for effective professional learning. Science teachers will be observed to collect trend data providing insight for program monitoring and evaluation. This data will be triangulated with data from student surveys and teacher interviews to provide a more comprehensive picture critical for establishing the framework for professional learning in the Turnaround School District moving forward. Observations and teacher feedback surveys will afford opportunities to formatively evaluate the program and adjust as needed while teacher interviews and student surveys will offer summative data to determine overall program success.

Research Questions

To effectively address the central phenomenon of producing more scientifically literate students by building teacher capacity with 3-D pedagogy through PD, the following research questions will be used to evaluate the action plan.

1. Does teachers' use of three-dimensional pedagogy improve as a result of engaging in the 3-D PD program?
2. Which factors do science teachers perceive most influence the adoption and transferability of three-dimensional pedagogy in DO schools?
3. Which supports do science teachers need to continue to employ three-dimensional instructional practices over time?
4. Does participation in the cadre contribute to collaboration and buy-in among science leaders across the district?
5. How does cadre participation influence program implementation?

Conclusion

Meeting the needs of teachers as they engage students in sense-making using three-dimensional pedagogy is critical for the academic success of students in science. Therefore, effective PD is essential to improve the capacity of elementary teachers as many are learning science content and instructional practices simultaneously. In Chapter Two, I will discuss the research associated with the characteristics of effective PD and its impact on student achievement. Chapter Three will contain a description of the development, implementation, and evaluation of the action plan.

CHAPTER II

LITERATURE REVIEW

Introduction

Surprisingly, educational professional development (PD) seems to be an enigma among researchers even in this time in which school districts in the United States spend billions of dollars to transform instruction and increase student achievement (Jacob & McGovern, 2015). Because PD is difficult to study, there has been limited empirical evidence to support its positive effects on student achievement (Yoon, Duncan, Lee, Scarloss, & Shapley, 2007). In a comprehensive review of evidence from research studies, Yoon, Duncan, Lee, Scarloss, and Shapley (2007) reported teachers who engage in sustained PD can increase student achievement by 21 percentile points. But after examining over 1300 studies, only nine met criteria for rigorous research according to the What Works Clearing-house standards.

Effective Professional Development

The dearth of evidence demonstrating a positive correlation between PD and student achievement illustrates a growing consensus among researchers as to the characteristics of effective PD. Garet, et al. (2001) conducted a national large-scale empirical study to examine the effects of characteristics of PD on self-reported teacher learning. A sample of 1027 math and science teachers were randomly chosen from 358 districts. To measure teacher outcomes, teachers were asked to rate their experiences in a variety of PD efforts funded by the Eisenhower Project. Results were calculated using a formal causal model providing evidence wherein sustained, content-focused, and coherent PD is more likely to impact teacher outcomes.

The study also revealed types of PD, whether traditional or reform, indirectly affect teacher outcomes through the other PD core features of collective participation and duration. Guskey (2003) analyzed 13 different lists compiled from various research organizations to determine what constitutes effective PD. He found that although criteria for determining effectiveness varied, some characteristics appeared more frequently. Among the most frequent were teacher content and pedagogical knowledge, time, collegiality and collaboration, and program evaluation.

Many PD programs resulting in positive outcomes for teachers and students have integrated the characteristics Desimone and Garet (2015) described in the following framework:

a) **Content focus:** activities focusing on subject matter content and how students learn the content;
b) **Active learning:** opportunities for teachers to observe, receive feedback, analyze student work, or make presentations, as opposed to passively listening to lectures;
c) **Coherence:** content, goals, and activities consistent with the school curriculum and goals, teacher knowledge and beliefs, the needs of students, and school, district, and state reforms and policies;
d) **Sustained Duration:** ongoing PD activities throughout the school year including 20 hours or more of contact time; and
e) **Collective participation:** groups of teachers from the same grade, subject, or school participate in PD activities together to build an interactive learning community.

The subsequent sections of this review will examine research specific to each of these characteristics of effective PD.

Content. The National Research Council reports in *A Framework for K-12 Science Education* (2012) science and engineering education should emphasize fewer disciplinary core ideas and leverage cross-cutting concepts allowing students to build content knowledge over time by engaging in practices of scientific inquiry and engineering design. Jeanpierre, Oberhauser, and Freeman (2005) looked at various core features of effective science PD using a mixed-methods approach to determine which characteristics of the program would impact teacher use of inquiry in Minnesota. After engaging five groups consisting of eight to 10 teachers and 16-20 students in authentic inquiry using monarch ecology, all teachers increased their use of inquiry in the classroom to varying degrees. All teachers content knowledge increased as determined by pre- and post-tests. Based on three teacher cases studies, researchers attribute the changes in teacher practice to science content development with multiple opportunities to practice, clear accountability requirements of teachers with a demonstration of competency, and high expectations for teachers from the PD providers. In order to make inquiry an integral part of teacher practice, teachers must have multiple opportunities to experience inquiry as a part of thinking through and planning for instruction.

Oliveira (2010) applied a mixed-method research approach to investigate how to improve teacher questioning in science inquiry discussions. A total of 15 teachers from eight public schools within a district in Indiana participated in professional development to not only improve their questioning, but also to increase their awareness of the social aspects of questioning helping to establish symmetric classroom relationships. As a result of participating in the institute, teachers asked twice as many questions encouraging students to express their thoughts and share their ideas suggesting an increase in student-centeredness questioning. Student-centered questions prompted higher levels of cognition encouraging students to engage in authentic scientific investigations. Teachers were able to recognize the cognitive and social functions of effective questioning. Both aspects should be considered when supporting students' engagement in inquiry learning experiences.

Buczynski and Hansen (2010) performed a case study to determine the impact of PD on teacher practice and student achievement in science. The researchers applied NSTA scientific inquiry guidelines to analyze classroom practices. The sample included 118 4th-6th grade teachers teaching a total of 3450 students from two urban school districts in California. After participating in one 35-hour weeklong institute of intensive content and inquiry pedagogy professional development, teacher content knowledge increased as indicated by pre and post exams. Additionally, fifth grade students saw some gains on state standardized tests. When comparing control and treatment groups from two districts, students of treatment teachers in one district scoring proficient or advanced increased by nine percent while students of teachers within the control group scoring proficient or advanced increased by two percent. In the second district, there was no change in percent of proficient or advanced students of treatment teachers, but students of teachers in the control group scoring proficient or advanced decreased by two percent.

Active learning. Heller, et al. (2012) researched the effects of three PD models on teacher knowledge and student achievement along with delayed effects the following year in 270 elementary schools with a total of 7000 students in 2007-2008 across six states. The three intervention models included Teaching Cases, Looking at Student Work, and Metacognitive Analysis. Compared to controls, all three intervention models improved student and teacher scores on selected-response science tests, but only

Teaching Cases and Looking at Student Work improved teacher and students written justifications for correct answers in the following year. The increase in student and teacher knowledge speaks to the positive effect of content specificity in PD. The Teaching Cases and Looking at Student Work interventions required in-depth analyses of student work which highlights the active learning feature of effective PD.

The Biological Sciences Curriculum Study (BSCS) developed a PD program in which teachers actively analyze instructional practice through the use of videos. Using quasi-experimental design, Roth, Garnier, Chen, Lemmens, Schwille, and Wickler (2011) to determine if PD with a focus on the analyses of teacher practice using the Science Content Storyline and Student Thinking lenses would affect teacher and student content knowledge in California. A total of 48 teachers with a corresponding 1490 students participated in the study. The program significantly improved teacher content knowledge compared to the control group and increased teachers' use of science strategies leading to higher average student gains. Teachers who participated in the program were able to retain content knowledge over a longer period of time suggesting future professional development should include analysis of teacher practice in addition to content. Evidence suggests the video-based analysis of practice made a difference in content knowledge because it was the only distinction between the control and experimental groups.

Coherence. While comparing three districts in New Jersey, Firestone, Mangin, Martinez, and Polovsky (2005) found districts can influence teaching through coherent professional development. As a result of various litigations, the New Jersey Supreme Court required districts to adopt whole school reform (WSR) programs. In turn, the state board of education allowed schools to adopt reform programs varying in several measures including content. The three districts observed in this case study implemented reform differently which led to different levels of PD coherence. District A chose a subject-oriented approach aligned with district and state goals with professional development being provided through one whole school reform program. Professional development in District B was not as coherent because schools were allowed to customize PD offerings based on teacher feedback and choice leading to the use of many WSR programs. District C exhibited the least coherence because central office employees provided PD as they saw fit without any communication or information sharing with their peers. Teachers from District A reported learning more about their content areas as well as authentic instructional strategies. These results seem to substantiate the findings regarding the positive effect of coherence on the development of teacher knowledge and skills (Garet et al., 2001).

Duration. Gallimore, Sanders, and Goldenberg (2009) investigated how an inquiry protocol for addressing instructional problems impacted student achievement. The researchers used a quasi-experimental design over a six-year case study. The framework applied to this case study included five elements: shared goal-setting, meaningful measuring indicators, assistance from capable others within the school, distributed leadership, and setting. Researchers encountered barriers to implementation during the first two years, but were able to adjust during the final years resulting in a significant increase in student achievement in nine scale up schools using the protocol compared to six schools using another California district-approved framework. Researchers hypothesized these gains were in part due to teachers shifting the attribution of improved student performance to their teaching as oppose to external influences beyond their control by working on problems long enough to discover connections between pedagogy and student learning.

Suppovitz and Turner (2000) analyzed 24 projects in the Local Systemic Change Initiative, a national group of projects funded by the National Science Teacher Enhancement program, to determine the impact of professional development on science teaching practices. Researchers analyzed survey data from 300 teachers and 300 principals. Researchers found a strong relationship between PD and science teacher practices. Teachers with more than two weeks of professional development rated teaching practices above average suggesting duration of PD is a critical factor for changing teacher practices.

Akerson and Hanuscin (2007) conducted a study in an elementary school in Indiana to determine if a professional development program could change teachers' beliefs regarding the nature of science (inquiry), affect change in teachers' instructional practices, and increase students' understanding of the nature of science. Bell and Gilbert's (1996) model for professional development was applied to focus on teachers' personal, social, and professional development in this program. Three of six teachers were selected for case studies. Classroom observations notes along with teacher and student interviews, questionnaires, lesson plans, and field notes from professional development workshops were used to collect data. Research revealed all teachers views of the nature of science improved after participating in the program. Due to the teachers' improved views of the nature of science and changes to inquiry-based instruction, students' views on the nature of science were more informed. This study supports other research suggesting professional development should be ongoing, and on-site support for teachers is a critical factor in effective professional development. Because of monthly workshops, teachers were able to develop ideas and refine practice over a three-year period decreasing the chances of reverting back to old habits.

Johnson, Kahle, and Fargo (2006) reported the importance of the duration of PD when examining the effects of sustained, whole-school professional development on student achievement in science. During the first year of this study, teachers spent time learning about inquiry and modifying lessons to include inquiry they later taught. However, researchers did not see any differences in student achievement until the second year after teachers had participated in 100 hours of professional development.

Collective participation. The collective participation feature of effective professional development is highlighted in Johnson and Fargo's (2010) research on urban school reform. Researchers applied the Transformative Professional Development (TPD) model to determine if teacher practices and student needs could be transformed over time through effective professional learning addressing teachers' personal, professional, and social development. The social development aspect of the model compelled all science teachers to build relationships with their colleagues and students. Researchers were able to achieve this collaboration by allowing teachers to co-construct the program while focusing on teacher and student needs. This proved to be very valuable in increasing morale especially since not all participants were volunteers. The implementation of TPD increased student achievement and changed teacher practices in urban school settings by the end of the second year of implementation.

In-addition, Johnson et. al (2007) used a quasi-experimental design to determine the relationship between whole-school professional development and student achievement. Researchers compared an experimental suburban middle school to a control school with similar demographics in Ohio. A total of 11 science teachers in two experimental schools participated in a summer institute and monthly meetings throughout the school year to implement inquiry-based learning and develop content knowledge utilizing a collaborative process. During monthly meetings, grade-level teachers worked together to modify curriculum and create inquiry-based lessons. The Discovery Inquiry Test was used to measure student achievement. Results indicated a relationship between whole-school sustained professional development and student achievement. There was no significant difference in achievement between schools during the first year, but a significant difference was seen in Year 2 and Year 3 of the study. Achievement in the experimental school increased more as time went on. This study produces evidence for whole-school sustained professional development providing the structure for teachers to collaborate, thereby enabling professional growth.

Lesson study is a type professional collaboration in which a group of teachers study the curriculum by developing a lesson on a particular topic. One member of the group teaches the lesson while the others collect data to discuss the effectiveness of the lesson in terms of student learning (Hart, Alston, & Murata, 2011; Lewis & Hurd, 2011). Akiba et al. (2019) researched the effects of lesson study design on collaborative teacher learning in Florida. Surveys were administered to 87 teachers across six districts to determine the relationships between design features of lesson study and teacher learning. The lesson design features studied included duration of the lesson study, the facilitator's foci on student thinking and active teacher participation, and the quality of materials. Because these variables were found to be strongly associated with teacher participation in an effective inquiry process, researchers hypothesized they should also be positively associated with teachers' perceived knowledge growth, self-efficacy, and expectations. Akiba et al. (2019) reported the facilitator's focus on student thinking was most strongly associated with teachers' perceived knowledge, efficacy, and expectation after statistical analysis of the survey responses. These findings make the case for districts and schools to strategically incorporate student thinking into collaborative learning experiences for teachers.

Researchers Coenders and Nellie (2019) utilized a qualitative case study method to make the case for lesson study as a form of professional development for novice and experienced teachers in the Netherlands. Two lesson study groups were the objects of this study in 2014-2015. Each team was composed of at least a veteran teacher, a novice teacher, and a representative from the local university. Results revealed lesson study increased teacher pedagogical content knowledge in both novice and veteran teachers according to interviews, reflective journals, and recordings. The collaborative development, enactment phases, and post-lesson discussions of the lesson study cycle were critical to the development of the teachers' pedagogical content knowledge.

Researchers Doppelt et al. (2009) evaluated the impact of a learning community approach to PD on teacher practice and student achievement when implementing a reform curriculum in a mid-size urban school district for two years. The researchers compared three groups; five teachers using the established curriculum with 405 students, five teachers using the reform curriculum with 274 students without PD, and 13 teachers using the reform curriculum with PD. The PD framework for this study was most closely aligned with content-based collaborative inquiry in which teachers actively learned by discussing students' understanding, collecting and analyzing data, sharing results with their colleagues, and collaborating to create instructional solutions (Zech, Gause-Vega, Bray, Secules, & Goldman, 2000). These researchers discovered students who were engaged in the reform curriculum and whose teachers received no PD not only performed lower than the students whose teachers received PD, but also lower than the students who engaged in the established curriculum. The results indicate the need for PD structured in a way creating a community of professionals when implementing a new curriculum.

Akerson and Hanuscin (2007) reported one of the features in their study ~~to~~ influencing teacher practice was collective participation. During monthly workshops, teachers were able to share ideas, provide each other with feedback, and develop assessment strategies while focusing on the nature of scientific inquiry. These workshops allowed project staff to identify and resolve problems by using this time to negotiate goals for learning with teachers.

Conclusion

In addition to exploring factors of effective professional development, it is important to highlight some of the potential barriers. According to Whitworth and Chiu (2015), the missing link for effective professional development is leadership. Implications from their literature review suggests it is critical to understand leadership's views of PD and PD practices in order to gain insight into PD choices and implementation. When leadership understands the value of a program, administrators are better equipped to support the intended outcomes and changes in teacher practice.

Johnson (2006) researched barriers to implementation of professional development and changes in practice by using a qualitative case study design. Johnson examined seven teachers across two schools in Ohio who were in their second year of the Discovery Model School Initiative. Findings indicated teachers encountered technical, cultural, and political barriers in both schools. However, the teachers in the school with unsuccessful implementation of the Discovery Model encountered more political barriers including lack of leadership support, resources, school-wide collaboration, and limited in-service. When creating professional development for school reform, leadership support, teacher beliefs, and collaboration are critical elements of effective implementation.

Desimone, Smith, and Ueno (2006) took a quantitative approach using data from the 2000 National Assessment of Educational Progress and a final sample size of 1,218 teachers to determine if teachers with the greatest need were receiving professional development. The researchers found teachers who already had more content knowledge as determined by their degrees in mathematics and self-reported preparedness to teach certain math topics were more likely to engage in sustained content-focused professional development. Teachers who reported feeling more prepared to teach a range of math topics were also more likely to engage in sustained content-focused professional development. This demonstrates teachers most in need of professional development are not getting it. Administrators should consider more creative alternatives for PD such as guiding teachers to more high quality PD and eliminating PD activities proven ineffective.

According to Guskey (2016), the ultimate goal of PD in education is to affect positive change in student outcomes. While it may be difficult to measure the direct effects of PD on student achievement (Yoon, Duncan, Lee, Scarloss, & Shapley, 2007), this literature review speaks to the measured changes in teaching practices as a result of PD participation with the idea of improved teacher practices leading to increased student achievement. Research demonstrates the need for PD to be content-specific, active, sustained, coherent, and collective with leadership paving the way for teacher motivation and change. Chapter three will describe how the action plan will address these factors for effective PD.

CHAPTER III

METHODS

Introduction

Even though new standards were adopted in 2016, the Turnaround School District was still experiencing challenges with implementation. However, charter and DO leadership began to focus more on science instruction due to the reintroduction of state-wide science testing in 2021. This chapter describes the identification of the problem of practice, the development of the action plan, and the program evaluation. Because program evaluations can build organizational capacity by engaging stakeholders in cycles of school improvement (Yarbrough et al., 2011), a program evaluation was utilized to determine the answers to the following research questions:

1. Does teachers' use of three-dimensional pedagogy improve as a result of engaging in the 3-D PD program?
2. Which factors do science teachers perceive most influence the adoption and transferability of three-dimensional pedagogy in the DO schools?
3. Which supports do science teachers need to continue to employ three-dimensional instructional practices over time?
4. Does participation in the cadre contribute to collaboration and buy-in among science leaders across the district?
5. How does cadre participation influence program implementation?

Close attention was paid to key stakeholders as their participation in the program contributed to the quality of the evaluation. Since teachers and students were the primary stakeholders of this program, it was necessary to solicit their perspectives and feedback throughout the process. Teacher interviews and student surveys provided critical information to not only assess their current knowledge of and experience with 3-D instructional practices, but also teachers' and students' experiences with the dimensions over time. In addition, observation data was collected to inform ongoing teacher support throughout the program and to measure program effectiveness. Other stakeholders who played key roles in the program evaluation were the members (district leaders) of the science cadre. They collaborated to analyze observation data from various schools to identify trends and challenges. The monthly analyses was used to develop content for school level and district-wide PD. District leaders benefited from the program evaluation because engaging in an improvement process provided participants with an experience which could be leveraged to increase capacity at the various school sites. A longitudinal review of observation data provided a measure for overall program effectiveness. All stakeholders benefited from their participation in the program evaluation as the processes were designed to improve practice whether building content and pedagogical knowledge and/or increasing organizational capacity.

This chapter is composed of three sections. The first section describes how the action plan was developed. This section includes a summary of involved stakeholders, a description of the problem of practice, and the research used to establish the action plan. The second section is a presentation of the action plan. Included is the description of each element, and how each element addressed the problem of practice. The final section of this chapter includes the program evaluation. Each element of the action plan is presented along with a goal and the multiple measures of quantitative and qualitative data collected to answer the research questions. The methodology used to address each research question is also included.

Action Plan Development

Upon arriving at the Turnaround School District in 2018 as the Lead Instructional Support Director, I learned the historical context and the nature of the relationships between central office and the charter management organizations (CMOs) within the portfolio of schools. Since the Turnaround School District had been primarily an authorizer of charters, there was little to no interaction between the previous instructional support providers from the central office and the schools. In fact, one executive director shared CMOs would actually have to pay for instructional support services from the central office staff in previous years. It became my mission to establish or improve relationships between CMOs and the central office. To begin this work, the academic team, consisting of three content directors and five content specialists, established an instructional component to an existing summer conference, developed a district-wide PD plan, and visited each school in the portfolio at least once per semester. During the school visits, the academic team learned most schools throughout the portfolio were more concerned with support for ELA and Math, not science. This was evident during classroom observations, needs assessments, and discussions between school leadership and our academic team.

While it was critical to district success to develop relationships with CMOs, the district directly operated three of 30 schools. The academic team quickly realized DO schools were similar to rest of the schools within the portfolio. Principals within those DO schools had between one and three years of experience as administrators. Even though curricula for ELA and math had been adopted, the curricula were not consistently being used effectively. There was no curriculum for science, and the subject was not being taught at all in some instances.

In the absence of a curriculum in many of the schools including the DO schools, the PD plan for science was pedagogy-driven. Upon completion of the PD, survey results from participants revealed high levels of satisfaction, but classroom observation results did not indicate the transfer of those pedagogical strategies to classroom instruction. In 2019, a science curriculum was purchased for the portfolio, and the DO schools were required to use it. The science curriculum provided much needed structure and content for science teachers as they were attempting to tackle the new standards adopted two years earlier. The new curriculum also provided structure for district-wide science PD. The science director and specialist approached the science PD plan differently with the purchase of the new curriculum, and now there was a focus on content and pedagogy. Five additional trainings were added. However, there was still a discrepancy between teacher satisfaction and classroom practice.

During a customary debriefing after a science PD session in the midst of the 2019-2020 school year, the science specialist and I began to brainstorm ideas to improve the transferability of strategies learned in PD to classroom practice. During our analysis, we realized there were several factors negatively influencing the identified problem. The inhibitors included inexperienced leadership at the school level, limited teacher pedagogical content knowledge, multiple teacher preparations, minimal instructional minutes, and lack of collaboration between central office and school staffs even so far as between teachers of the same grade-level content. We knew some of these factors were beyond our control. We decided to focus on collaboration and pedagogical content knowledge, specifically employing three-dimensional instructional practices in science classrooms.

Collaboration among professionals is a critical component of effective professional learning. Desimone et al. (2015) claims professional learning is more likely to occur when a community of teachers from the same grade and content area collectively participate. The science director and specialist realized this was a challenge in the Turnaround School District because most science teachers are singletons, meaning they are the only one in their schools teaching a particular grade-level subject. In addition, many of the science teachers are responsible for teaching another core content subject. The expectations of a teacher responsible for both math and science require a very high level of not only organizational efficiency, but also pedagogical content knowledge. It is almost inconceivable to think teachers can effectively teach both math and science, especially those teachers with less than five years of experience. To increase collaboration among science teachers, the district's science team decided to establish a cadre for science leaders and teachers. The cadre would create a network of like-minded individuals who could exchange ideas and resources who would otherwise plan in isolation.

In 2018, district-led science professional development was more traditional in as it was a series of whole group workshops primarily focusing on building teachers' understanding of three-dimensional instruction. The science team determined in September this was the most pressing need because classroom observation data and instructional needs assessments revealed a lack of awareness of the new standards and limited understanding of the three-dimensions even though new standards had been adopted two years prior. Because a science curriculum was purchased the following year, the focus of the PD became more content-driven. However, the professional learning opportunities were provided in the same whole-group, traditional manner. Even with a new curriculum and a new PD focus, we did not see the instructional shifts needed for students to master science standards. As a result, the entire academic department revisited its approach to instructional support. While we could not change the traditional format for district-wide PD as recommended according to Garet et al. (2001) due to the level of autonomy afforded to the CMOs, we could change our focus and target audience.

Previously, the academic team had directly supported teachers via district-wide PD, small group PD, and/or individual instructional coaching. Initially, this appeared to be what was needed, so the academic team immediately began this work. Upon reflection, the academic team realized we needed to build capacity within the schools because teachers needed more access to sustained support than district personnel could provide. Johnson et al. (2007) highlighted, in their longitudinal study on the effect of whole-school, sustained PD on science achievement, positive impacts on student achievement only in the second and third years of the program after a hundred hours of PD. One of the disconnects between professional development and classroom practice was the on-site support for teachers because a science team of two individuals could not provide sustained PD to approximately 90 science teachers throughout the district. To address this issue, the academic team decided to change our target audience from teachers to content leads and instructional coaches. This change would ensure support was provided to those individuals as teachers engage in more reform types of PD at the school level as opposed to the traditional type of PD the district provided in previous school years.

Action Plan

The 3-D PD program was designed to improve three-dimensional instructional pedagogy in the Turnaround School District. The first element of the action plan was to establish the science cadre (SC), and the second element was to develop 3-D PD for DO schools.

Science Cadre. The primary purpose of the cadre was to foster collaboration and create buy-in among science leaders across the district. The SC contributed to the coherence of PD across the district as PD was developed in alignment to the goals of the SC and needs of teachers and students (Desimone et al., 2015). The science team advertised the cadre as an opportunity for learning and leadership in the summer of 2020 to recruit members. Fortunately, due to the advertisement and financial incentives provided by the district, half of the CMOs and two thirds of the direct-run schools are represented in the cadre.

The professional learning component of the SC was an immersion of cadre members into scientific inquiry, three-dimensional instruction, and characteristics of effective PD. Cadre members spent two weeks in the summer of 2020 engaging in the inquiry module from the VISTA professional learning program developed by Biological Sciences Curriculum Study. Since the state's science standards were derived from *A K-12 Framework for Science Education*, the foundation for three-dimensional pedagogy starts with inquiry. It was critical for science content leads to understand students will only mimic real-world scientists by engaging in inquiry. Members of the SC continued to engage in deep dives of disciplinary core ideas throughout the life of the program using phenomena-driven inquiry, science and engineering practices, and cross cutting concepts. The professional learning and collaboration among SC members occurred across two four-day institutes and six virtual study groups spanning from September 2021 until March of 2022. Increasing the expertise of the SC members enhanced the promotion and transfer of 3-D pedagogy to classroom practice throughout the Turnaround School District.

The leadership component of the SC required members to establish goals, analyze current science PD practices within the schools and the district, develop a science observation instrument, and observe instruction. SC members analyzed their current PD practices according to five levels of data to gauge impact (Guskey, 2016) and the characteristics of effective PD (Desimone et al., 2002) to make the necessary adjustments in school-level PD to improve the transferability of professional learning to classroom instruction. Guskey (2016) claims five levels of information must be considered to effectively evaluate PD. They are 1) Level 1: Participants' Reactions, 2) Level 2: Participants' Learning, 3) Level 3: Organizational Support and Change, 4) Level 4: Participants' Use of New Knowledge and Skills, and 5) Level 5: Student Learning Outcomes. To determine transferability, SC members were required to submit informal observation data to the SC twice per semester. This provided Level 4 data examining whether new knowledge and skills acquired from various 3-D PD programs throughout the district were being implemented.

Prior to establishing the cadre, we did not solicit feedback from content leads before developing the district PD plan or content. We did administer needs assessments to teachers, but not to content leads and instructional coaches. The cadre provided a voice to those content leads and instructional coaches whose ideas and needs had not been considered in past years.

Professional Development. The second element of the action plan was to engage teachers in multiple professional learning opportunities designed to improve three-dimensional pedagogy at the school and district levels. The SC determined not only the content for district and school PD, but also developed or fine-tuned the model for PD within their respective schools or CMOs. All teacher PD was to begin with a deep dive into the observation instrument (See Appendix A) which is grounded in the three-dimensions: disciplinary core ideas, science and engineering practices, and cross-cutting concepts. After which, school level PD differed from school to school as determined by identified trends and individual teacher needs according to observation findings. Types of PD included small group such as PLCs, individual instructional coaching, and/or lesson study.

Since I had more latitude to develop the 3-D PD program within the DO schools, the DO schools offered additional teacher and student data otherwise not produced by the SC. The DO schools acquired additional teachers in 21-22 to establish three-man teams in the upper elementary grades for full departmentalization. The DO schools used the same master schedule providing a structure favorable for collective participation in PD. In other words, singletons from each of the three schools within the same grade-level content had planning at the same time. This allowed content leads the opportunity to provide 3-D PD during the school day and teachers to collaboratively plan immediately implementing what they learned from 3-D PD with support from content leads. Teachers within the DO schools participated in 3-D PD two times per month and collaborative planning two times per month. Prior to implementation of 3-D PD, science content leads within DO schools completed a needs assessment to determine areas of focus for support provided by the science director and specialist. The director and specialist collaborated with content leads within the DO schools to develop a consistent and job-embedded 3-D PD plan.

The science director and specialist in collaboration with content leads within the DO schools developed a PD pacing guide which chunked the three-dimensions providing a focus for the first three quarters in support of content leads. The first quarter focus was phenomena-driven instruction, the second quarter focus was science and engineering practices, and the third quarter focus was cross-cutting concepts. The disciplinary core ideas were embedded within each focus. To determine the transferability of new knowledge and skills from 3-D PD to classroom practice, grades 3-5 teachers were observed three times.

Table 1 Program Elements

Element	Goals	Timeline	Who	Budget
Science Cadre	Short-term – District science leaders feel supported and prepared as they lead teachers in their schools Long- term – Increased collaboration amongst science leaders across the district	July 2020 – March 2022	Science leads across the district	$75,000
Professional Development	Short-term – Teachers develop a deeper understanding 3-D pedagogy. Long term – Improved 3-D pedagogy in science classes and increased student achievement	School Level July 2020 – March 2022 District-Level July 2020 – March 2022	Science teachers	$200,000

The Evaluation

The purpose of the program evaluation was to determine whether the described action plan accomplished the goal of improved use of 3-D instructional practices in science classes. Each of the two elements identified in the action plan, the SC and PD, had an associated set of research questions utilizing qualitative and quantitative methods.

Science Cadre. Two research questions were posed to study the impact of the SC on the overall success of the program. The first question sought to discover if the SC contributed to collaboration and buy-in among science leaders across the district. The second question attempted to ascertain how SC participation influences 3-D implementation.

To measure the impact of the science cadre on collaboration, cadre members' interactions were observed to document exchanges of ideas in six monthly meetings from September 2021 until March 2022. These results were captured in transcribed meeting notes and analyzed for emerging themes. SC members took a survey (See Appendix D) at the end of the program to determine how SC participation influenced collaboration throughout the district. To document SC participation, attendance was recorded for all SC meetings, and the numbers of deliverables were recorded for each member.

Cadre members were responsible for observing instruction in their schools on a monthly basis and submitting data to the cadre at least two times per semester to determine the level of implementation of 3-D instructional practices. The observation tool consisted of indicators with accompanying numerical descriptors between one and four (See Appendix A) and a record of written evidence of what is seen, said, and done. If implementation was increasing and improving, an upward progression should have been seen in the observation scores over time. To further analyze implementation, results from district walkthroughs allowed for a comparison among schools with cadre representation and those without. It was the aim of the district to visit all 27 schools at least once per semester although eleven schools were not represented in the SC. Analyzing this data helped determine how SC participation influenced the level of implementation of 3-D instructional practices throughout the district.

Attendance and records of deliverables were used to corroborate SC survey data (See Appendix D) to strengthen the validity of the results for collaboration and buy-in as documented in the SC meeting notes. SC survey results provided a quantitative measure as evidence of changes in practices of SC members. Observation data from science classes conducted by SC members was used to substantiate results of the SC surveys. The science director and specialist conducted district science walkthroughs and the data spoke to the level of implementation of three-dimensional pedagogy in science classes across the district. The perspective of the science director and specialist was used to corroborate the reports of implementation from the members of the cadre. The results from the district walkthroughs was compared to the observation results from the SC to determine if findings could be reinforced.

Professional Development. The purpose of this element was to provide science teachers with the necessary training and skills to increase and improve 3-D pedagogy. Three research questions were posed in this study to fully explore this element.

To determine if teachers' use of three-dimensional pedagogy improved as a result of engaging in the 3-D PD program, data was collected from observations throughout the program. The mean of the observation scores was calculated at the beginning and end of the program. The percent change of the mean will help determine whether 3-D PD impacted classroom practice. In addition, a t-test was performed to determine if the mean of the observations scores at the end of the program were significantly different from the mean of the observation scores at the beginning of the program.

Fourth and fifth grade students within the DO schools completed surveys (See Appendix B) after the program to determine if their knowledge of and experience with 3-D pedagogy increased as a result of the program. The students survey responses and classroom observation data was used to corroborate the results of the teacher interviews. If teachers reported an increased use of 3-D pedagogy, this should have been evident in student survey responses and classroom observation data. Data from at least three classroom observations aided in determining the number of teachers within the DO schools implementing 3-D pedagogy and to what degree. The observations provided ongoing checkpoints for program implementation and needed adjustments for continuous teacher support. Classroom observations were used to substantiate data from teacher interviews and student surveys. If teacher and students reported an increase in 3-D pedagogy, observation results should have also demonstrated increased use of 3-D pedagogy. An analysis of classroom observation results over time helped measure program effectiveness. A running record of PD attendance at the school sites was used to measure the percentage of PD participation. PD participant surveys were used to adjust subsequent school level PD sessions as needed and measure participant satisfaction at the school sites.

To explore which factors science teachers perceived most influenced the adoption and transferability of 3-D pedagogy, teachers were asked the following questions in an interview:

1. Which factor most influenced your use of 3-D practices (district PD, small group PD, collaborative planning, instructional coaching, district expectations, administrative expectations, content lead expectations)? Why/how?
2. Which type of support did you find most effective? (large group/district support, small group/school support, individual support)?

A chi-square test was performed to determine if the distribution of respondents is equal as hypothesized, or if there was a statistical difference in the frequency of the selection of factors which most influence use of 3-D practices. However, the sample size was too small to obtain valid results. Therefore, the results for the most effective type of support was compared to the results for supports needed to continue the use of 3-D practices.

The results from each of these statistical analyses supported past research suggesting PD can affect change in instructional practices (Jeanpierre, Oberhauser, & Freeman, 2005; Oliveira, 2010; Suppovitz & Turner, 2000); These results also shed light as to which type of PD wasd most effective, reform or traditional (Johnson et al., 2007), but a small sample size may have affected the test results.

Table 2 Research Questions and Evaluation Data

Element	Research Questions	Goals	Sub-Elements	Sub-Element Timeline	Evaluation Data
Science Cadre	Does participation in the cadre contribute to collaboration and buy-in among science leaders across the district?	Short-term – District science leaders feel supported and prepared as they lead teachers in their schools	Professional Learning	July 2020	Qualitative & Quantitative Formative – classroom observations
			Development of Observation Instrument	August 2020	
	How does cadre participation influence program implementation?	Long- term – Increased collaboration amongst science leaders across the district	Report Observation Results and Identify District Trends	November 2020 – February 2022	Qualitative and Quantitative Summative – cadre meeting notes and district walkthroughs
			Present Problems of Practice and Refine CMO or School Level PD	November 2020 – February 2022	Quantitative Summative – cadre attendance and SC surveys
PD	Does teachers' use of three-dimensional pedagogy improve as a result of engaging in the 3-D PD program?	Short-term – Teachers develop a deeper understanding 3-D pedagogy and feel supported as they make these instructional shifts.	Observation Tool Deep Dive	November 2020	Qualitative and Quantitative Formative – classroom observations and observations of school-level PD
			District Level	September 2020 – March 2022	
			School Level		
	Which factors do science teachers perceive most influence the adoption and transferability of three-dimensional pedagogy in the direct-run schools?	Long term – Improved 3-D pedagogy in science classes and increased student achievement		November 2020 – March 2022	Qualitative and Quantitative summative – Teacher interviews and analysis of all classroom observations over time
					Quantitative Formative – PD feedback surveys
	Which supports do science teachers need to continue to employ three-dimensional instructional practices over time?				Quantitative Summative – pre and post student surveys, school-level PD attendance

Conclusion

Improving 3-D pedagogy was the objective of this action plan. Because teachers became more skillful users of 3-D pedagogy, the possibility of increased student achievement in science improved. However, the instructional shifts for science teachers was proven difficult. Therefore, collaboration and constant building-level support was critical.

Collaboration among teachers improved as a result of a structural change within DO schools. All DO schools implemented the same master schedule to ensure common planning for teachers of the same grade-level content. Collaboration among district science leaders improved due to the participation in the SC.

Content leads were to provide constant and consistent support for teachers in DO schools while receiving support from the SC, science director, and specialist. However, this did not always occur due to other responsibilities and duties of the content leads. The SC was designed to establish a network for those building level support providers to learn and problem solve. The content leads used knowledge gained from the SC, science director, and specialist to in turn immerse science teachers in the three dimensions and provide the support and capacity to implement effective three-dimensional instruction.

CHAPTER IV

RESULTS

Introduction

The intent of this study was to improve three-dimensional (3-D) pedagogy utilizing professional development. This study was developed in response to a need for teachers to deliver science instruction fully aligned to new science standards and ultimately, increase student achievement in science even though the state's and district's primary foci had been reading and math.

The Turnaround School District is a portfolio district with nine different charter management organizations operating 26 of 29 schools. The remaining three schools are directly operated by the district. The district is the state's most intensive intervention for chronically low-performing schools. Because many of the students come from poverty-stricken homes and lack exposure to experiences outside of their neighborhoods, the district began to realize science could be used as a motivational tool to appeal to students' natural curiosities and develop critical thinking skills, especially if taught the way the new science standards required.

The new science standards presented a steep learning curve for teachers, particularly in elementary schools as most elementary school teachers do not specialize in science. In response to this need and the review of literature, an action plan was developed collaboratively by the researcher, science director, science specialist, and various other science leaders throughout the district to provide targeted professional development to teachers. Targeted professional development along with grade-specific collaborative planning were chosen as methods to help teachers develop a deeper understanding of 3-D pedagogy and content. In addition to professional development for a subset of teachers within district-operated schools, the district established a science cadre to foster collaboration and create buy-in for implementing 3-D pedagogy among science leaders in the district. Chapter Four provides findings related to the following research questions:

1. Does teachers' use of three-dimensional pedagogy improve as a result of engaging in the 3-D PD program?
2. Which factors do science teachers perceive most influence the adoption and transferability of three-dimensional pedagogy in the DO schools?
3. Which supports do science teachers need to continue to employ three-dimensional instructional practices over time?
4. Does participation in the cadre contribute to collaboration and buy-in among science leaders across the district?
5. How does cadre participation influence program implementation?

Research Question One

To determine if the use of three-dimensional pedagogy improved as a result of engaging in the 3-D PD program, teachers receiving the treatment were observed at the beginning, middle, and end of the program using the 3-D Observation Tool (Appendix A). The observation tool measures implementation of all three dimensions of 3-D pedagogy: disciplinary core ideas, science and engineering practices, and cross-cutting concepts. Most indicators on the observation tool are measured on a scale of one to four with one indicating no or very little implementation and 4 indicating full implementation. Four indicators on the observation tool require a yes or no response. Teachers received zero for a no response, and one for a yes response. The highest possible rating on the observation tool is 31.

The central tendencies are displayed in below in Table 3. The mean of observation scores improved throughout the program with the overall average increasing from 33.87% in Observation 1 to 38.17% in Observation 3. The largest range of 29.03 and standard deviation of 12.64 was found in Observation 3 scores.

Table 3 Central Tendencies

	Observation 1	**Observation 2**	**Observation 3**
Range	25.80	25.80	29.03
Mean	33.87%	37.10%	38.17%
Median	29.03%	35.48%	35.49%
Standard Deviation	10.55	8.83	12.64

Table 4 *t*-Test Results

	Observation 1	**Observation 3**
Mean	33.87	38.17
Variance	111.32	159.86
Observations	6	6
df	10	
t Stat	0.64	
P(T<=t) one-tail	0.27	

Note: *t*-Test results assuming equal variances.

Even though there was a 12.70% increase in the average observation scores over time, a *t*-Test reveals the difference is not statistically significant when comparing averages of

Observation 1 and Observation 3. Table 4 shows the findings revealing a non-significant result (p = .27).

Table 5 Observation Scores

Teacher	Observation 1		Observation 2		Observation 3		Change
	Total Points	Percent	Total Points	Percent	Total Points	Percent	Percent Change
1	16.00	51.61	13.00	41.94	17.00	54.84	6.26
2	8.00	25.81	8.00	25.81	10.00	32.26	24.99
3	13.00	41.94	16.00	51.61	16.00	51.61	23.06
4	8.00	25.81	11.00	35.48	12.00	38.71	49.98
5	9.00	29.03	10.00	32.26	8.00	25.81	-11.09
7	9.00	29.03	11.00	35.48	8.00	25.81	-11.09
Average		33.87		37.10		38.17	12.70

Note: N = 6

Nine teachers participated in this study; however, three of the teachers were not able to be observed three times throughout the program. Therefore, their data were excluded. A deeper dive into the data displayed in Table 5 revealed all but Teacher 5 and Teacher 7 improved from Observation 1 to Observation 3. Both teachers' scores decreased over the three observations by 11.09%. However, the most improvement was exhibited by Teacher 4 with a 49.98% increase. Even though Teacher 5 and Teacher 7 did not show overall improvement, they both exhibited improvement from Observation 1 to Observation 2 with 11.13% and 22.22% growth respectively. The overall decrease in observation scores for Teachers 5 and 7 could be explained by their waning PD attendance going from 75% for both of them during the beginning months of

October and November to 50% and 25% for the final months of January and February. The observation score for Teacher 1 decreased by 18.75% from Observation 1 to Observation 2 while the observation score of Teacher 2 remained the same.

PD and collaborative planning was offered twice per month for five months totaling ten opportunities for professional learning. PD attendance is displayed in Table 6. Teacher 1 did not begin employment until December of 2021; therefore, Teacher 1 was only employed during the last six offerings bringing the attendance rate for Teacher 1 to 66.66%. Teacher 2 and Teacher 4 had the lowest PD attendance rates at 30%.

Table 6 PD Attendance

	Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Total**	**Percent**
Teacher 1*	0	0	2	2	0	4	66.66%
Teacher 2	2	0	1	0	0	3	30.00%
Teacher 3	2	1	1	1	0	5	50.00%
Teacher 4	2	0	0	0	1	3	30.00%
Teacher 5	2	1	1	1	1	6	60.00%
Teacher 7	2	1	0	0	1	4	40.00%
Total	10	3	5	4	3	25	44.64%

*Teacher 1 was employed during the last six PD offerings.

Table 7 presents the observation score average, attendance rate, and years of experience teaching science for each teacher. It is important to note Teacher 1 had the highest PD attendance rate, observation average, and number of years teaching science while Teacher 2 had the lowest attendance rate, observation average, and number of years teaching science.

Table 7 Observation Averages, Attendance Rates, and Experience

Teacher	Attendance (Rank)	Average Observation (Rank)	Science Teaching Experience (Rank)	Evidence Statements from Interviews
1	66.66% (1)	49.46% (1)	4 (1)	"I have a more in-depth understanding of the levels of teaching."
2	30.00% (6)	27.96% (6)	1 (6)	"It helps me to know what everyone is looking for."
3	50.00% (3)	48.39% (2)	4 (1)	"I have more confidence in teaching and that gives them confidence in learning."
4	40.00% (4)	33.33% (3)	3 (2)	"3-D PD has not changed my instructional practices."
5	60.00% (2)	29.03% (5)	2 (5)	Not Interviewed.
7	40.00% (4)	30.11% (4)	3 (2)	"It helps me to be mindful with some form of hands-on."

To determine the relationship, if any, between PD attendance, average observation, and years of experience teaching science, a Pearson correlation test was performed. The results are exhibited in Table 8. These results revealed a moderate correlation between PD attendance and average observation scores with a Pearson coefficient (r) of .59, but there was an even stronger correlation between teaching experience and average observation scores with a Pearson coefficient of .85.

Teacher 2 who had the lowest PD attendance rate, the lowest observation average, and the least experience stated 3D-PD helps him to know what everyone is looking for. His answer to the question of how PD has changed his knowledge and practice of 3-D instruction did not indicate he had any understanding of 3-D pedagogy. The same is true for Teacher 7. His statement PD has helped him to be mindful with some form of hands-on instruction is an actual contradiction to what 3-D pedagogy is really all about and how it was presented during PD.

Teacher 4 was the only teacher teaching both science and math because a third-grade math teaching position had not yet been filled. Even though he expressed his instructional practices had not changed, this was not consistent with his observation scores as he had the highest percent increase in observation scores of 49.98%.

Table 8 Correlations

	Attendance	Science Teaching Experience	Average Observation
Attendance	1		
Experience	0.55	1	
Average Observation	0.59	0.85	1

To further determine the impact of the 3-D program on the use of three-dimensional instructional practices, students in grades four and five took a survey to assess their knowledge and use of the three-dimensions. The student survey was an attempt to triangulate data from the classroom observations and teacher interviews. The student survey asked students to rate their utilization of two of the dimensions by converting each science and engineering practice and cross-cutting concept to a kid-friendly statement. The third dimension of 3-D instruction, disciplinary core ideas, are the big ideas relative to the scientific discipline. When teachers implement the standards-aligned curriculum, the disciplinary core ideas are automatically included. Therefore, there was no need to assess implementation of this dimension as the disciplinary core ideas are dictated by the standard. For each statement, students could select how often they engaged in a practice or concept (I don't know, never, sometimes, always). A selected response of "I don't know" possibly indicated the lack of use of a practice or cross-cutting concept. There were ten statements on the survey examining the implementation of the science and engineering practices, and seven statements on the survey examining the use of the cross-cutting concepts. Surveys were administered to the students of four teachers. The original intent was to administer the survey to the fourth and fifth grade students of six of the nine teachers participating in the program. Two of the six classes were not able to be surveyed because of excessive absences due to the pandemic. The remaining three teachers taught third grade students, and the researcher thought the survey may not have been developmentally appropriate for eight-year old students who are struggling readers. The results are in Table 9 and Table 10.

Slightly over 70% of all students reported always or sometimes using SEPs. Approximately 10% of all students reported never using the SEPs, and 19.19% did not know whether they had used the SEPs.

Teacher 1 exhibited the highest observation average at 49.46% and the highest percentage of students reporting always or sometimes utilizing the SEPs at 93.64%. The results were similar for Teacher 1's implementation of the cross-cutting concepts. When asked how 3D-PD changed her knowledge of three-dimensional instruction and practices, Teacher 1 stated,

> It (3D-PD) gave me a more in depth understanding of the practices that are going to be taught in the classroom. Before the PD, we would just start teaching. We

never thought about cross-cutting concepts. It helps with planning and makes the class flow easier.

Table 9 Student Survey Results for Science and Engineering Practices

Teacher	Number of Responses	Always	Sometimes	Never	I do not know
Teacher 1	110	63.64%	30.00%	3.64%	2.72%
Teacher 3	100	37.00%	38.00%	8.00%	17.00%
Teacher 6	240	23.34%	35.00%	13.33%	28.33%
Teacher 8	170	31.18%	40.00%	10.59%	18.24%
All	620	34.84%	35.97%	10.00%	19.19%

Note: The number of responses per teacher differing is a result of differences in class size.

Table 10 Student Survey Results for Cross-Cutting Concepts

Teacher	Number of Responses	Always	Sometimes	Never	I do not know
Teacher 1	77	70.13%	23.38%	0%	6.5%
Teacher 3	70	30.00%	38.57%	10.00%	22.86%
Teacher 6	168	23.34%	35.00%	13.33%	28.33%
Teacher 8	119	22.68%	35.29%	15.97%	26.05%
All	434	30.88%	31.57%	10.37%	27.18%

Note: The number of responses per teacher differing is a result of differences in class size.

Teacher 3's students reported the second highest percentage of use of the SEPs and CCCs at 75.00% and 68.57%. Teacher 3 had the second highest observation score average as well at 48.39%.

Observation scores for Teacher 6 and Teacher 8 were not included in the data because these teachers were not able to be observed a sufficient number of times for this study. However, both reported changes in their knowledge and practices as a result of 3D-PD. Teacher 6 reported 3D-PD changed the way he "sets up" his lessons. He expressed planning is more difficult when utilizing 3D practices which is consistent with observation averages displayed in Table 3.

Research Question Two

To determine which factors teachers perceived most influence the adoption and transferability of three-dimensional pedagogy, teachers responses were analyzed from an interview during which the question, "Which factor most influenced your use of 3-D practices?" was asked. Teachers were given the following choices: small group PD, district PD, collaborative planning, instructional coaching, district expectations, school administration expectations, and content lead expectations. Results from this question were cross-tabulated with the responses from another interview question asking teachers to reveal which type of support was most effective given the choices large-group/district support, small-group/school support, or individual support.

Results in Table 11 reveal of the nine teachers interviewed, five reported some type of professional development as being the most influential factor in their employment of three-dimensional instruction while the other four reported expectations as being the most influential factor. Instructional coaching was the most common professional development chosen by three teachers, and district expectations was chosen more than school administration expectations and content lead expectations.

Glaringly, none of the teachers reported school PD or school administration expectations as the most influential factor. District expectations were consistently communicated to teachers during professional development and collaborative planning. It is not known whether or to what extent school administrators communicated expectations for science instruction.

Table 11 Teacher Interview Data

	Professional Development				**Expectations**		
Most Effective	District PD	School PD	Collab Planning	Coaching	District	School Admin	Content Lead
Large Group / District	1	0	0	1	3	0	0
Small Group / School	0	0	1	0	0	0	0
Individual	0	0	0	2	0	0	1

More than half of teachers reported large group / district PD as being the most effective type of support. Teachers experienced large group / district PD during in-service and two after school sessions. Reasons for reporting large group / district PD as the most effective type of support included more cohesive, more informative, and additional time.

Of the five teachers who expressed large group / district PD as the most effective type of support, two teachers reported PD as the most influential. The remaining three teachers reported expectations as being most influential. This finding speaks to the importance of PD and expectations. While PD is certainly needed to improve 3-D pedagogy, the power of expectations cannot be denied. Only one teacher reported collaborative planning as being the most influential type of PD and small group / school PD as being the most effective.

Research Question Three

Data collected from teacher interviews was comparatively analyzed to determine if there was an equal distribution of respondents for the supports needed to continue the use of 3-D pedagogy. Since there were three choices for each question, one would expect 33.3% of participants to select each option. The three options were large group/district, small group/school, or individual support. A comparison was made between expected outcomes and observed outcomes to determine if there was a difference in the frequency of teachers' responses. Table 12 reveals the results.

Table 12 Supports Needed to Continue

Supports	Observed	Expected Based on Most Effective
Individual	4	3
Small Group/School	2	1
Large Group/District	3	5

These results contrast with the number of teachers reporting the most effective type of as large group/district support. Even though Table 11 indicates five of nine teachers reported large group/district PD as being most effective, only three of nine teachers expressed large group/district support is needed to continue to implement 3-D pedagogy. One might expect since five teachers reported large group/district PD was most effective, at least five would have reported large group/district PD was needed to continue use of 3-D pedagogy. Teacher 6 who reported large group/district PD as being most effective stated, "I would actually like a small setting if I could get more time." Garet et al (2001) found reform PD is more effective typically because it tends to last longer and includes more collective participation. In this study, the opposite occurred. Large group PD, which was more traditional, lasted longer than small group PD and individual coaching indicating the importance of time.

Research Question Four

To assess the level of collaboration and buy-in amongst science leaders across the district, a survey was administered, and the virtual science cadre meetings were recorded, transcribed, and coded to look for emerging themes. The notes were analyzed a second time to extract direct quotes from participants to validate the results of the survey. The findings are displayed in Table 13.

The survey was completed by six of ten members of the cadre. All respondents agreed or strongly agreed their participation in the cadre provided them with a network of support from individuals in similar roles across the portfolio. All respondents agreed or strongly agreed their knowledge of three-dimensional instruction had increased as a result of participating in the cadre. Furthermore, all respondents agreed or strongly agreed their participation in the cadre either improved their own use of 3-D instructional practices or how they supported teachers when implementing 3-D instructional practices. Continuing, all respondents agreed or strongly agreed the use of three-dimensional instructional practices had improved in their schools or networks as a result of their advocacy for 3-D instructional practices. And finally, 83% percent of respondents agreed or strongly agreed their support and/or advocacy for 3-D instructional practices led to organizational changes.

To measure collaboration and buy-in during the cadre meetings, the communication among the members were analyzed and categorized as a simple contribution to the group, a revelation of new learning, or a change in perception or practice. A simple contribution was defined as a response to a question or a statement to express one's own or someone else's thoughts.

Table 13 Cadre Collaboration and Buy-in

Survey Results	Evidence Statements from Cadre Meeting Observations
Participation in the cadre provided me with a network of support from individuals in similar roles across the portfolio.	"I've done tons of PD before I started this one (the cadre). So, a lot of it I already knew, but all of the resources you provided were so handy for me as I delivered my PDs." "Some of the things that we've used in here like the articles, we've used in our school trainings." "To piggyback off of that, I think our line of questioning has to be spot on." "I agree with what everyone else has said. Understanding those components and how the students are referencing the phenomenon throughout the lesson."
Participation in the cadre increased my knowledge of three-dimensional instructional practices.	"Before the cadre, I didn't know the acronyms. Now I can truly say I know what the SEPs, CCCs, DCIs are." "I used to think I was looking at good lessons, but now I know I was missing the mark". "This has been good for me because it is stretching my thinking." "After hearing your old-school analogy, I changed my viewpoint."
Participation in the cadre improved my own use of three-dimensional instruction or how I support teachers when implementing three-dimensional instructional practices.	"Before, I felt like I was just teaching content. Now I teach with purpose and intention. The big thing is inquiry." "I have added glows and grows to my observation tool." "This is pushing my leadership, and helping me to know where I need to push teachers."

	"Practicing being a leader in the cadre has made me a better teacher and follower of leaders."
The use of three-dimensional instruction has improved in my school or network due to my advocacy.	"I became better with what to look for in science lessons and giving feedback on lesson plans." "I have been able to support teachers by helping them to use phenomena." "We're not hitting all three-dimensions in every lesson, but the awareness of what they are is so much higher."
My support or advocacy for three-dimensional instruction has led to organizational changes.	"It's day and night. We went from not teaching science to teaching science, to actually having lesson plans for science, to actually giving feedback to science teachers, to looking at data for science." "I actually advocated for science teachers within the budget. We really need to put science on its own because the science/math split does not work."

Often, these contributions to the discussion signaled an interaction in which members of the cadre were exchanging or expanding ideas. This type of interaction was evident when a member would start his or her contribution to the discussion with "I want to piggyback off of…". This phrase was recorded several times throughout the cadre meetings.

Revelation of new learning was documented when cadre members acknowledged the acquisition of new content or pedagogical knowledge. Some of the members would make references to past practices to demonstrate new knowledge. For instance, one member stated, "I used to think I was looking at good lessons, but now I know I was missing the mark." Others expressed having a better understanding of the three dimensions after having participated in the cadre.

A change in perception was evident when cadre members realized an alternative to their old way of thinking or practice. One member communicated when she learned inquiry was not as much hands-on as much as it is minds-on, it took the pressure off her and teachers to incorporate activities requiring so many supplies and materials. Another member expressed a change in her viewpoint on the purpose of a teacher circulating as students are working after hearing a colleague provide an analogy.

During its first year, the attendance for the science cadre meetings never fell below 77% with all members submitting at least two observations. However, participation, attendance, and deliverables declined during the second year. Former cadre members reported limited time since returning to in-person instruction, the negative effects of COVID-19, and fatigue as factors contributing to the decline. In spite of the decline in participation during the second year, current and former cadre members reported having increased knowledge of 3-D pedagogy, knowing how to better support teachers implementing 3-D pedagogy, gaining a network of colleagues to collaborate with, and using their advocacy to invoke organizational change. Even though district walkthroughs could not confirm changes in classroom practice in charter-operated schools, the cadre was an opportunity to plant seeds of knowledge to begin cultivating the spread of 3-D pedagogy throughout the district.

Research Question Five

The final research question sought to determine the impacts of the cadre on the implementation of three-dimensional instructional practices across the district by comparing the observation data from district walkthroughs of schools represented in the cadre to schools not represented in the cadre. Six observation scores were randomly generated from each data set. Table 14 provides the findings. While the average observation score is greater in schools with cadre representation, a *t*-Test revealed the difference in average observation scores is not statistically different (p = .16). However, the results do indicate a practical difference.

Table 14 Cadre Schools Compared to Non-Cadre Schools

Observation	Cadre	Non-Cadre
1	54.84%	45.16%
2	41.94%	32.26%
3	35.48%	29.03%
4	32.26%	25.81%
5	25.81%	25.81%
6	25.81%	22.58%
Average	36.02%	30.11%

Another finding revealed observations conducted by cadre members tended to yield higher scores than observations conducted by the science director and science specialist during district walkthroughs. To determine if the difference was significant, the average observation scores were calculated for all schools represented in the cadre when observed by a cadre member and when observed during district walkthroughs. Table 15 shows the average score for cadre-conducted observations compared to observations conducted by the district-walkthrough team is significantly higher (p = 2.83E-05).

After reviewing the observation data and examining the rating evidence of the cadre-conducted observations, the science director and specialist noticed the evidence was highly inferential instead of being factual suggesting cadre members were not familiar with best practices when conducting observations.

Table 15 Cadre Observations Compared to District Observations

School	Cadre	District	Difference
1	76.67%	25.81%	50.86%
2	68.57%	25.81%	42.76%
3	40.01%	36.56%	3.45%
4	83.87%	30.65%	53.22%
5	74.19%	25.81%	48.38%
6	83.87%	29.04%	54.83%
7	61.29%	32.26%	29.03%
8	83.87%	22.58%	61.29%
Average	71.54%	28.57%	42.97%

Some of the inferential evidence included statements such as:

1. "Teachers made explicit connections to the prior lesson and the upcoming lesson to help students build their content knowledge in a coherent manner."
2. "The teacher asked some probing questions."
3. "The teacher asked questions during the video and posted questions for a class discussion."

When looking at these evidence statements, it is difficult to tell if the statements are true, or if they contributed to students' overall understanding of the objective. When looking at the first and second statements, the teacher may have mentioned both the prior and upcoming lessons; however, one cannot assume explicit connections were made. The same issue is present in the second statement. One cannot ensure the questions were probing. The third statement may be factual, but it is not specific enough to help determine whether the questions really pushed student thinking and facilitated discussion in a manner which helped students master the objective.

Conclusion

Participation in the 3-D PD program resulted in growth for all stakeholders. Even though observation ratings did not show a statistically significant difference over the course of implementation, the average observation ratings did increase indicating some improvement.

Teacher interviews provided valuable information to the district team. Almost just as many teachers reported expectations were most influential in their adoption of 3-D pedagogy as PD. Even though none of the teachers reported small group / school PD as being most impactful, two of the teachers reported needing small group / PD to continue to utilize 3-D pedagogy. This insight encourages the district team to expand its focus beyond PD to ensure all stakeholders realize the importance and benefits of 3-D pedagogy, especially school leaders.

The cadre provided an opportunity to encourage charter operator schools to implement 3-D pedagogy through collaboration with other leaders throughout the district. Meeting transcripts provided evidence of contributions to the group, new learning, and changes in perception.

Chapter 4 presents the findings of the study both qualitatively and quantitatively. Chapter 5 provides an analysis of those findings, along with limitations of the study, and recommendations for future study.

CHAPTER V

DISCUSSION

Introduction

The purpose of this study was to improve three-dimensional (3-D) instruction in science classrooms throughout the Turnaround School District. The discovery of the stark contrast in data collected from classroom observations and feedback from PD surveys illuminated a need to build teacher capacity. Even though PD had been provided in the past, the district team had not intentionally focused on the components effective PD needed to increase the transferability of knowledge gained during PD to classroom practice. Garet and Desimone (2015) describe effective PD as content-specific, active, coherent, collective, and sustained in duration.

Based on this framework, the district team developed an action plan to address this need to make PD more effective. PD was provided over a five month period and instruction was observed to determine effectiveness. Observation data indicated an improvement of 3-D instruction in district-operated (DO) schools. Chapter One provides the purpose and justification for the study. Chapter Two consists of a review of the research. Chapter Three describes the development of the action plan, the action plan, and the evaluation of the action plan. Chapter Four is a presentation of the findings. Chapter Five concludes by presenting ~~presents~~ an analysis of the findings, describes the application of the program evaluation standards, discusses the limitations of the study, and provides recommendations.

Analysis

3-D PD. When developing the action plan for this program, Desimone's and Garet's (2015) framework for effective PD was applied to increase the probability of program effectiveness. The framework asserts there are five components of effective PD: content focus, active learning, coherence, collective participation, and duration. While all of these components were considered during the development of the action plan, there were some challenges in implementation.

Content-focus. Effective PD focuses on specific subject matter and how students learn the subject matter (Desimone & Garet, 2015). To ensure science teachers had a person devoted to science support within the school buildings, the district asked principals of DO schools to designate a science content lead. This designee would be responsible for delivering science PD and supporting teachers with implementation of 3-D instructional practices. All three principals appointed assistant principals as science administrative content leads.

One assistant principal had no science teaching experience, and the other two had only taught science prior to the adoption of the new standards. Initially, the content leads were on board but soon realized their own content deficits making them more and more hesitant to carry out the responsibilities of the content lead. The content leads' lack of content knowledge required them to spend more time with the district team to guarantee content presented to teachers during PD and collaborative planning was accurate. This necessitated an extensive commitment which ultimately proved too difficult for the assistant principals as this responsibility often conflicted with their many other duties and obligations.

Active learning. To maintain an active learning environment during collaborative planning, the district team developed a framework for teachers to discuss their past and future practices, develop a lesson plan, and deliberately practice a portion of the lesson plan. After developing the lesson plan, science content leads were to observe instruction and follow up the observation with a coaching conversation to engage teachers in reflection and develop next steps for upcoming lessons.

Professional development was designed to be collaborative sessions during which teachers experienced 3-D instruction as students, learned new science content, and discovered misconceptions. After experiencing 3-D lessons as students, teachers engaged in a discussion, facilitated by the district team, to analyze the 3-D instructional practices within the lessons.

A couple of factors negatively impacted the active learning component of the action plan. Teachers were asked to complete pre-work prior to collaborative planning to make the most of the time spent together diving into the lessons with their content peers. The pre-work consisted of dissecting the standard, reading the content background, and determining possible student misconceptions. Many times, teachers came to collaborative planning not having done the required pre-work. Therefore, some of the collaborative planning sessions were reduced to unpacking the standards. This minimized time left for planning and deliberate practice.

In addition, there were several instances in which science content leads did not observe instruction after collaborative planning or engage teachers in a coaching conversation after the observations. The lack of follow through disrupted the plan and decreased the opportunities for teachers to improve their practice of 3-D instruction. This may also explain why none of the teachers chose school administration expectations as the factor that most influenced their adoption 3-D pedagogy.

Coherence. PD is most effective when it aligns with state, district, and school goals. The state of Tennessee developed a vision for science instruction when it adopted new science standards in 2016. However, state support of implementation has not proven successful as many districts are still struggling to fully implement the science standards six years ~~later~~ after adoption. To address this issue, a goal for science achievement was established by the district and documented in the district's improvement plan. This plan was made available to all school leaders as the goals of their school improvement plans must align with the district's goals. The district made other efforts to not only communicate the science goal to all stakeholders, but also to achieve the science goal. The district hired personnel to support science instruction, the district newsletter included a dedicated space just for science news and announcements, the science goal was shared during every PD and collaborative planning session, the district purchased a science curriculum which was used during PD and collaborative planning, and the district established a science cadre to promote 3-D instruction throughout the district.

While these action steps were all needed for successful implementation, the district's efforts were overshadowed by the state's lack of focus on science. When examining accountability data, the state only includes math and reading to determine school effectiveness. The inaction of the state to incorporate science in the overall school success rates of schools caused school leaders to deprioritize science instruction. The lack of focus on science was evident when principals did not always hold time for collaborative planning and PD sacred allowing teachers to opt out, scheduling other required meetings for teachers during the time allotted for science planning and PD, and not clearing a path for assistant principals to engage in the work with fidelity. In addition, principals used federal funding to hire instructional coaches for reading and math support, whereas they appointed assistant principals as content leads to support science teachers regardless of their instructional backgrounds.

The school administrative expectations for science instruction was inconsistent with the expectations of the district as evidenced by the dearth of science support in the school buildings. Teachers not choosing school PD as the most effective type of support, nor school administration expectations as most influential in their employment of 3-D instructional practices speaks to the need for the district to seek other ways to encourage school administration to buy into the importance of science instruction especially in the school turnaround environment.

Duration. The initial action plan for sustained duration was to provide four PD opportunities per month over a five-month period totaling 20 hours of sustained PD excluding district-wide PD offered during teacher in-service training and two after-school sessions. However, the total PD offerings were reduced to two opportunities per month over a five month cutting the total duration in half. This limited contact was due to a compromise between district personnel and principals as principals desired to use the other two opportunities for monthly grade level PLCs and vertical teaming.

Another issue adversely affecting the sustained duration of the PD throughout the program was COVID-19. The pandemic affected all participants at some point throughout the program as either teachers contracted the virus, was documented as a close contact of someone who contracted the virus, or experienced schedule changes at work because one or more of their colleagues were absent as a result of the virus. At one point in time, two of the three schools had to cease operations for a week because too many of the staff had fallen ill at one time. The effects of COVID-19 can be seen in PD attendance. Attendance was highest during the first month of the program with at least five teachers attending both PD opportunities. Nevertheless, the next highest PD attendance rate was in December, during which time one teacher attended twice and three others attended once.

According to the review of literature, effective PD needs to be sustained for 20 hours or more throughout the school year. Even though more than 20 hours of PD was offered outside of the 3-D PD program, the amount of PD each teacher received was inconsistent and less than the recommended 20 hours, still some improvement was revealed in the observations scores over the course of the program. Because there was a moderate correlation between PD attendance and observation scores, one could expect even more improvement with longer duration.

Time also appeared to be a prevalent reason among teachers who reported large group / district PD as being most effective. Large group / district PD typically lasted at least twice as long as small group / school PD because of the limited minutes during the school day. Large group / district PD was held all day during in-service or for two hours after school, whereas small group / school PD was held for an hour during teachers' planning periods. Even though five teachers chose large group / district PD as the most effective type of support, only three chose large group / district PD as the type of support needed to continue to utilize 3-D pedagogy.

One teacher explained he likes the smaller group, but he wanted more time within the smaller group. This finding suggests teachers may benefit from a change in the design of the program. During in-service and after school PD, the district can increase human capacity by utilizing content leads from the cadre to present PD allowing teachers to remain in those small groups.

Collective participation. Efforts were made to include the collective participation component of effective PD in the 3-D PD program. The master schedule for all three schools was crafted to provide all grade level science teachers with common planning time virtually. This action afforded the structure needed for collaboration amongst science teachers who taught the same grade level content. Otherwise, science teachers would have had to planned in isolation.

Science content leads from the three schools were able to take advantage of this change in the master schedule as they were able to share the load of support with each being responsible for supporting one grade during collaborative planning. Because the participants were able to virtually engage with their grade level colleagues, PD and collaborative planning was lesson-specific as all teachers were using the same curriculum and pacing guides.

Science Cadre. The purpose of the science cadre (SC) was to foster collaboration and create buy-in among science leaders to implement 3-D instructional practices across the district. The two components of the SC were professional learning and leadership. The professional learning component was designed to develop pedagogical content knowledge of support providers as 3-D instruction was new to the cadre members even though the members occupied various support roles for science teachers within their respective organizations. The leadership component was designed to help cadre members reflect on their support of science teachers and possibly adjust their PD models or plans to increase the implementation of 3-D instructional practices. We examined buy-in according to a scale that started with awareness being on the lower-end of the scale and advocacy leading to organizational change on the higher end of the scale. While 83% of respondents agreed their advocacy led to organizational change, there was not as much evidence to support this finding. Lack of evidence for organizational change may have been due to the fact that some of the cadre members were teachers and felt limited by their roles within the schools not taking their advocacy beyond their own classrooms.

Results revealed significant discrepancies between cadre-conducted observations and district-conducted observations. A reason for such a significant difference in the observation averages among cadre-conducted observations and observations conducted by the district team could be because of the tendency of cadre members to give teachers the benefit of the doubt. All members of the cadre either were currently teachers or had been teachers prior to becoming an instructional coach or content lead. Most had only been in support roles less than a year. One member stated "I always put my teacher hat on" when conducting observations. While it is important to empathize with teachers, biases can develop causing the key levers for change to be overlooked when observing instruction.

During observation norming, discussions among cadre members revealed tendencies to rate higher when the observers saw positive student behaviors such as engagement or hands-on activities. However, these behaviors, while important, are not always indicators of 3-D instruction. Scientific inquiry, the cornerstone of 3-D pedagogy, necessitates students develop explanations for naturally occurring phenomena. More often than engaging by doing, developing explanations require engaging by thinking.

While the cadre survey results and meeting transcripts revealed a heightened awareness of 3-D instruction, participation in the cadre was diminished in the second year of its existence. Several members withdrew in the second year citing limited time and fatigue as reasons. During the first year of the cadre, the world was operating virtually because of the pandemic. However, during the second year teachers and students returned to school. There was an intense focus on learning loss due to the pandemic which put an unusual amount of pressure on teachers and support providers. The cadre was a microcosm of what was happening in schools across the entire district. School personnel were tired and simply did not want to take on any additional responsibilities or continue in the profession at all. Because of the limited cadre participation, it was difficult to determine if effective PD and support for 3-D instruction was occurring in schools outside of the DO schools.

Program Evaluation Standards

The standards of the five attributes for program evaluation were applied to evaluate this program. A systematic investigation of the program provided knowledge critical for program improvement.

The first attribute, utility, refers to the extent of which an evaluation benefits all of the involved stakeholders (Yarbrough et al., 2011). Teachers developed a deeper understanding of 3-D pedagogy and how their students perceived implemented instructional changes via feedback from student surveys. Students received strategic instruction designed to encourage them to use prior knowledge and newly crafted learning experiences to explain phenomena. Teacher interview data provided content leads with ongoing feedback regarding the teachers' experiences during collaborative planning and PD sessions so content leads could adjust for future sessions. This generally resulted in content leads recognizing the enormity of the responsibilities of instructional leaders and developing empathy for teachers. Cadre members developed relationships with other district leaders creating a community of learners with the same goal of improving 3-D pedagogy throughout the district.

While all stakeholders were informed of the purpose of the program and evaluation, evidence suggests principals in the DO schools did not always recognize the immediate benefits of the program or the evaluation. Principals often prioritized math and reading over science.

Feasibility, the second attribute, speaks to the effectiveness and efficiency of the program evaluation. Tending to feasibility is an iterative process depending on context and time (Yarbrough, 2011). Initially, part of the evaluation plan included pre and post student surveys to gain the students' perspectives on implementation of 3-D pedagogy to coincide with the teacher observation ratings over time. However, inconsistent student and teacher attendance due to

COVID-19 made conducting the second student survey impractical as there were entire classes of students and teachers absent due to the schools' adherence to close contact COVID protocols.

There were several resources used to carry out the evaluation including time, willing participants, science content specialists, data, and funding to compensate stakeholders for their participation. These resources contributed to the feasibility of the program evaluation.

Propriety is the third attribute, and it describes the extent to which precautions are taken to protect the participants (Yarbrough, 2011). To ensure propriety, data collection tools were submitted to and approved by the Institutional Review Board at the university. Teacher participants were assigned identification numbers to ensure anonymity and confidentiality of observation results and qualitative data collected from teacher interviews. Student and SC surveys were conducted anonymously, and personal identifiers were removed from SC meeting transcripts.

The fourth attribute, accuracy, describes the validity and reliability of the findings and representations of the data (Yarbrough, 2011). Data collected for the program evaluation included teacher observations, recorded teacher interviews, meeting transcripts, student surveys, and cadre surveys.

The observation scores of teacher participants who were not able to be observed three times during the program were not used to calculate observation averages. To determine the impact of the SC on the implementation of 3-D pedagogy, observations scores of teachers in schools represented in the SC were compared to observation scores of teachers in schools not represented in the SC. Six observation scores were randomly generated from each data set to strengthen the validity of the results.

Teacher interviews and cadre meetings were recorded to ensure accuracy of perceptions and quotes. Transcripts were generated from cadre meetings to allow for coding and can be used to verify reported results.

The final attribute of program evaluation is accountability. Standards for accountability ensures adequate documentation of the evaluation (Yarbrough, 2011). Each element of the program was evaluated utilizing quantitative and/or qualitative methods. To determine implementation of 3-D pedagogy in DO schools, six of nine teachers were observed throughout the program at least three times. A total of 14 observations were completed in non-DO schools during district walkthroughs and 32 observations were completed in DO schools. In addition to ratings on individual indicators, written evidence was provided to support the ratings on the observation tool. Hundreds of pages of meeting transcripts were read and analyzed to determine the effectiveness of the SC.

Limitations

There were physical and statistical limitations in this study. The initial plan was to include all nine science teachers within the DO schools in the research. However, a couple of unforeseen issues prevented three teachers from fully participating. Two of the teachers were absent for extensive amounts of time due to the pandemic. The third teacher transitioned from fifth to second grade in the middle of the program. Therefore, a full set of observation data could not be collected for them.

Another limitation was the small sample size for this study. The original intent was to perform a Chi-square test to determine if there was a statistical difference between expected and observed outcomes regarding the types of support needed for teachers to continue to employ 3-D pedagogy. A sample size of less than five times the number of cells is not recommended as it can affect the results making the recommended sample size for this study 30 (McHugh, 2013); however, the sample was nine. Even though the validity of the quantitative analyses in this study could have been strengthened by a larger sample size, the results served as a starting point providing practical information necessary for the Turnaround School District to improve program outcomes.

Social desirability bias could have impacted survey results from students and cadre members. Social desirability bias occurs when participants respond to surveys to manage the impression of themselves or others instead of responding according to their actual beliefs and values (Larson, 2018). Students may have responded more favorably on the survey to prevent their teachers or themselves as being perceived in a negative manner. Cadre members may have answered more favorably on their survey as they may not have wanted to disappoint district personnel even though the survey was anonymous.

Recommendations

The purpose of this study was to improve the use of 3-D pedagogy in science classes throughout the Turnaround School District. Therefore, teacher performance was the primary focus. However, future studies should be extended to include the effects of 3-D pedagogy on student achievement as student achievement is the ultimate goal for all school reform as well as PD. Another opportunity for research could examine the cumulative effects of PD on teacher performance given the high correlation between teacher experience and the implementation of 3-D pedagogy in this study.

For attempts to replicate this study, there are several things I would encourage future researchers to undertake differently. Investing more time in the beginning with school leaders to ensure impactful PD and collaborative planning at the school level could have possibly led to higher levels of implementation of 3-D pedagogy. It became increasingly clear throughout the study principals had not bought into the program. This negatively impacted implementation.

Asking more open-ended questions during the teacher interviews would have provided more data regarding teacher perceptions of their implementation of 3-D pedagogy. Valuable information was gained from the interviews; however, in hindsight, there was not enough teacher reflection. Teachers potentially walked away from the interview feeling that further improvement was solely the responsibility of the district minimizing teacher and school accountability.

A content lead should only be responsible for supporting science teachers. Assistant principals could not fully commit to responsibilities required of the content lead. Instructional coaches dedicated to science would be ideal.

Finally, opening the enrollment for the science cadre would have been helpful once membership and participation started to decline. More members could have increased the district's reach across the portfolio toward the goal of increasing and improving 3-D pedagogy throughout the district.

Implications and Conclusion

Implementing 3-D pedagogy is difficult, even for experienced teachers. In this study, the most experienced teachers achieved the highest observation ratings, but those ratings only represented slightly above half of the possible points on the observation tool. PD and collaborative planning exposed teacher deficits in pedagogical and content knowledge, and the enormity of building capacity in both content and pedagogy proved to be overwhelming for teachers and support providers. This study lasted five months, and teachers demonstrated some improvement. However, time and changes in policy and practices are needed to fully achieve effective implementation of 3-D pedagogy.

This study presents several implications for stakeholders at every level. To increase effectiveness, teachers need to specialize in science content even in elementary schools. Currently, many elementary classrooms are self-contained meaning teachers are required to teach all core subjects. Prior to the adoption of more rigorous standards, it was easier for teachers to effectively deliver instruction in self-contained classrooms as standards were skills-based. Now, standards are more conceptual requiring teachers to have a deeper understanding of all of the content. What is being asked of teachers in self-contained classes is nearly impossible which could explain in part why many are leaving the profession, especially in a world of high-stakes testing and rising accountability. School administrators should departmentalize to clear the path for teachers to learn and deliver instruction for one core subject. Frustrated and fatigued teachers do not benefit students.

District and state policy makers must ensure policies and procedures are not counterproductive to effective instruction. In its attempt to improve science instruction, the state adopted more rigorous science standards in 2016. However, the state did not assess student achievement in science, thereby removing it from the accountability framework used to determine school effectiveness. In fact, science achievement is still not included in the accountability framework six years later, even though the science assessments were operationalized last year. As a consequence of this practice, districts and schools have deprioritized science throughout the state.

In addition, the state should examine its current licensing policies and practices for elementary teachers. Currently, a teacher holding an elementary education K-5 endorsement can teach any and all core subjects, yet teachers do not receive enough specialized training in any one core subject in their educator preparation programs. This is not the case for secondary teachers as they often complete undergraduate degrees in a specific content before then obtaining a specialized teaching endorsement. If the goal is for teachers to be more effective for our students, then time, money, resources, and support must be aligned to ensure continued teacher growth so students with the highest needs are getting the best teachers.

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List of Appendices

APPENDIX A: 3-D OBSERVATION TOOL

Science Classroom Observation for Three-Dimensional Instruction*

Grade-appropriate elements of the science and engineering practice(s), disciplinary core idea(s), and crosscutting concept(s), work together to support students in three-dimensional learning to make sense of phenomena and/or to design solutions to problems. Each lesson or unit of study should provide opportunities for students to:

a. develop and use specific elements of the practice(s) to make sense of phenomena and/or to design solutions to problems.
b. develop and use specific elements of the disciplinary core idea(s) to make sense of phenomena and/or to design solutions to problems.
c. develop and use specific elements of the crosscutting concept(s) to make sense of phenomena and/or to design solutions to problems.
d. use all three dimensions to support their sense-making of phenomena and/or to design solutions to problems.

The lesson meets the demand of the standard(s)	The lesson meets the expectations as written in the standard(s) 4 - Fully meets, 3 - Mostly meets, 2 - Partially meets, 1 - Does not meet/Unclear
Does the lesson reflect the three-dimensional nature of the standards (disciplinary core ideas, science and engineering practices and crosscutting concepts)?	
A. A phenomenon or problem (intended to help students make sense of the world) aligned to standards (DCI, SEP, CCC) is chosen to drive the lesson	1 (Yes) a phenomenon aligned to the standards is used to anchor the lesson 0 (No) No phenomenon aligned to the standards is used to anchor the lesson Evidence:
B. Materials and/or activities integrate at least 2 and are moving toward 3 of the dimensions of the standards (DCI, SEP, CCC) • DCI ___________________________ • SEP ___________________________ • CCC ___________________________	1(Yes) The materials and/or activities integrate at least 2 and moving toward 3 of the dimensions of the standards 0 (No) The materials and/or activities DO NOT integrate at least 2 and moving toward 3 of the dimensions of the standards Evidence:
C. The materials and/or activities reflect the grade level expectations of the standard(s)	1 (Yes) The materials and/or activities reflect the grade level expectations of the standard(s) 0 (No) The materials and/or activities DO NOT reflect the grade level expectations of the standard(s) Evidence:

Does the lesson employ instructional practices integrating the three dimensions of the standards and allow students to make sense of the content?	
Support Statement	**Classroom Evidence** (4 – Developed, 3 – Adequate, 2 – Partial, 1 – Minimal or Not Observed)
A. Teacher makes explicit connections to the prior and/or upcoming lessons to help students build their understanding of content in a coherent manner	4 - Connections are explicit to help students' understanding of content in a coherent manner, 3 - Connections are explicit but do not contribute to students' understanding of content in a coherent manner, 2 - Connections are implicit yet students are able to build their understanding of the current content but coherence is lacking, 1 - Connections are implicit and students are not able to build their understanding of content in a coherent manner Evidence:
B. Teacher uses demonstrations, simulations and investigations to help students develop models/representations of the science content over time and demonstrate knowledge of disciplinary core ideas	4 - Demonstrations, simulations, investigations are used during the lesson to help students make their thinking visible 3 - Demonstrations, simulations and investigations are used during the lesson but students are not able to make their thinking visible, 2 - No demonstrations, simulations or investigations are used in the lesson, yet students are attempting to make their thinking visible, 1 - No demonstrations, simulations or investigations are used in the lesson Evidence:
C. Teacher models and supports the ways scientists operate and communicate (such as asking how and why questions, organizing data and observations, searching for new ideas from resources)	4 - Teacher frequently uses and references the SEPs during the lesson, 3 - Teacher infrequently uses and references the SEPs during the lesson 2 – Teacher does not use but references the SEPs during the lesson, 1 - Teachers does not use or reference the SEPs during the lesson Evidence:
D. Teacher helps students bridge disciplinary boundaries and unite core ideas	4 - Teacher frequently uses and references the CCCs during the lesson, 3 - Teacher infrequently uses and references the CCCs during the lesson 2 – Teacher does not use but references the CCCs during the lesson, 1 - Teachers does not use or reference the CCCs during the lesson Evidence:
E. Teacher facilitates discussions through skillful probing to support	4 - Teacher uses a variety of prompts to facilitate discussion such as - explain, cite the evidence, what did you observe, analyze, show, summarize, tell me more,

sense making of the science concepts	can you add on to what your peer has shared - to support sense making, 3 - Teacher uses a limited set of prompts to facilitate discussion to support sense making, 2 - Teacher facilitates discussion using a variety of prompts but they do not support sense making, 1 - Teacher does not facilitate discussions as questions are limited to worksheets, responses between individual students and the teacher. Evidence:
F. Teacher monitors individual and group work to elicit student ideas, share trends, highlight student thinking and support whole class sense making of the content	4 - Teacher circulates the classroom monitoring group and/or individual work, looking for the quality of the responses and collecting examples to be used in whole class sense making, 3 - Teacher circulates the classroom monitoring group and/or individual work, looking for quality responses without collecting examples to be used in whole class sense making, 2 - Teacher circulates the classroom monitoring group and/or individual work, looking for completion of tasks and not the quality of the responses, 1 - Teachers does not circulate the classroom monitoring group and/or individual work Evidence:

*This tool is an adaptation of a combination of Achievement Partners' instructional practice guides, Instruction Partners' rough draft of a science instructional practice guide, Next Generation Science's EQuIP rubric, and Colorado's grade reporting criteria for science.

APPENDIX B: TEACHER INTERVIEW PROTOCOL

Interview Protocol for ASD Science Teachers

Research Topic

Three-dimensional instructional practices in science classes

Statement of Consent

Thank you for meeting with me today to share your experiences using three-dimensional instruction. The information you provide will be critical in helping me to understand the employment of the three-dimensions throughout all ASD direct-run schools and how to better support science teachers in their use of the dimensions. Research findings will be reported without any of your identifiable information. Do you agree to proceed with the interview?

Icebreaker

Present each participant with a science teacher's survival kit including a magnifying glass, calculator, and science poster as a token of my appreciation for their participation.

1. How long have you been teaching? Science?
2. How has 3-D PD increased your knowledge of 3-D instruction?
3. How has 3-D PD changed your instructional practices?
4. What, if any, changes have you observed in your students as a result of using 3-D practices?
5. Which factor most influenced your use of 3-D practices (small group PD, district PD, collaborative planning, instructional coaching, district expectations, administrative expectations, content lead expectations, other)? Why/how?
6. Which type of support did you find most effective? (large group/district PD, small group/school PD, individual support)

7. What supports do you need to continue to use 3-D pedagogy? (large group/district PD, small group/school PD, individual support)
8. What suggestions do you have for the improvement of 3-D PD?

APPENDIX C: STUDENT SURVEY

	I Don't Know	Never	Sometimes	Always
1. My science teacher starts class with a phenomenon.				
2. In science lessons,				
a. My teacher asks questions that make me think.				
b. I ask questions that build my understanding of the topic.				
c. I develop and use models.				
d. I analyze and interpret data.				
e. I use math in science class.				
f. I develop claims and find evidence to support them.				
g. I develop explanations to explain phenomenon.				
h. I make predictions and develop ways to test them.				
i. I communicate my learning in writing or verbally to my teacher and/or my classmates.				
3. To help me make sense of the phenomenon,				
a. I identify patterns.				
b. I determine cause and effect relationships.				
c. I identify all of the related parts of the phenomenon and how they interact.				
d. I determine how the changes in those parts affect the stability of the whole.				
e. I examine the effects of size and quantity.				
f. I examine the relationship between structure and function.				
g. I recognize how energy and matter flow(s) into an out of the system.				

APPENDIX D: SCIENCE CADRE SURVEY

How long have you been a part of science cadre? ______________________________

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. My participation in the science cadre					
a. Provided me with a network of support from individuals in similar roles.					
b. Increased my knowledge of inquiry, phenomenon-driven instruction and 3-D instructional practices.					
c. Equipped me to better support science teachers within my CMO/school.					
d. Has provided me with resources to help improve my practice.					
e. Equipped me to improve my support for teachers and/or instructional practices.					
f. Empowers me to better advocate for science instruction within my CMO/school.					
2. Because I am a member of the science cadre.					
a. The way I support science teachers when implementing 3-D instructional practices, or my own use of 3-D instructional practices has improved.					
b. I have advocated for changes in science instruction within my CMO or school.					
3. As a result of my support and/or advocacy for 3-D instructional practices within my organization or school,					
a. The use of 3-D instructional practices has improved in my CMO or school.					
b. My CMO or school has made organizational changes to improve science instruction					

VITA

Alethea Nickole Henry

Profile

Educator devoted to creating a supportive environment for schools that fosters dedication to the progression of the social and intellectual abilities of students by establishing ongoing, open, and honest dialogue with all stakeholders that leads to reflection and continuous improvement in content knowledge and pedagogical practices of teachers and school leaders especially within high need populations.

Education

M.S. Leadership
May 2005, University of Memphis

Secondary Teaching Certification
June 2000, Rhodes College

B.S. Biology
May 1996, University of Memphis

Certifications

Administration and Supervision

Secondary Education
Biology Endorsement

Honors

School Improvement Grant Writer and Recipient

Redesign Grant Writer and Recipient

Memphis Urban Systemic Initiative Grant Writer and Recipient

Two-time Memphis City Schools Technology Literacy Grant Recipient

Innovative Planning Grant Writer and Recipient (Above the RIM)

Community Garden Grant Writer and Recipient

Relevant Work Experience

Chief of Instructional Support *(2020-Present)*

- Interacts with executive directors of charter management organizations to provide instructional support, feedback, and recommendations
- Calculates academic composites for the school performance framework and communicates results to charter management organizations
- Supervises staff by establishing departmental standards to effectively select, train, motivate, delegate, monitor and evaluate performance to ensure targets and goals are met
- Develops, presents, and defends program budget requirements; oversees and approves program expenditures and prepares financial forms and reports
- Oversee academic grants by procuring services, monitoring compliance, and engaging with external vendors
- Designs, plans and implements district-level professional development opportunities addressing instructional content, curriculum, instructional methods, and assessment in the classroom

- Support schools in the school improvement planning process and coordinate milestone visits with the Division of School Turnaround
- Analyzes state and district assessment data to help target professional development needs
- Serves as a strategist and visionary for content instructional support
- Serves as a data collector, analyzer, and decision maker

***Instructional Support Director** (2018-2020)*

- Established a student-centered instructional coaching framework that focuses on student learning, not "fixing" teachers
- Successfully challenged team to create a menu of support options that can accommodate all schools' instructional needs
- Secured talent with proven results in turnaround work and enacted quality controls for professional learning that has resulted in high praise from participants throughout the district according to surveys given after every learning experience
- Coordinated the full implementation of ELA, Math, and Science curricula within a two-month time frame
- Established academic collaborative partnerships with more than half of charter management operators when there were none previously
- Developed a long-term professional development plan to help principals empathize with teachers, utilize data, provide meaningful feedback, and develop content knowledge

***iZone Instructional Support Director** (2017-2018)*

- Provided overall support and direction for a team of twenty-five
- Assessed status of instructional support within all iZone schools
- Developed and adjust action plans for instructional support of teachers
- Collaborated with district leaders to create professional development for school leaders in various content

***iZone Instructional Support Manager** (2016-2017)*

- Provided overall direction and support for a team of high school instructional coaches with various content backgrounds
- Created tools to assist coaches with documenting, analyzing, and prioritizing their work with teachers
- Analyzed data to determine needs and trends that informed professional development for instructional coaches
- Developed a team culture by establishing cross-content committees that assisted with data, culture, public relations, research, and technology
- Developed relationships with building level administrators that resulted in positive outcomes for teacher development and school achievement (TVAAS improvement and removal from state's high priority list)
- Coordinated and provided professional development for instructional coaches and school-level instructional leaders
- Collaborated with iZone Leadership to determine next steps for instructional support

iZone Science Coach *(2013-2016)*

- Provided instructional support to teachers that resulted in double digit gains for 77% of schools in science.
- Recognized the need for establishing protocols within the iZone which led to the development of the coaching framework and handbook
- Organized, coordinated, and led meetings to develop coaching framework and handbook
- Developed the coaching institute to provide professional development and training for colleagues
- Consistently collaborated with iZone leadership to establish direction for the instructional support team
- Observe coaches and provide feedback using a cognitive approach to help improve coaching practices
- Engage in reflective practice to continuously revise and adjust coaching methodologies
- Collaborated with peers to design and deliver professional development and one-on-one coaching as needed
- Analyzed data for iZone schools to monitor trends and assess teacher and school needs in the science department
- Collaborated with school and district personnel to create individual professional growth plans for teachers and administrators, provide professional development, and hire additional staff

Performance Improvement Team Coach *(2013)*

- Provided coaching support and managed learning coaches using the Cognitive Coaching Framework
- Provided instructional and coaching support to teachers in eight schools within the Southwest Region
- Created and presented professional development based on data and according to school needs
- Observed and evaluated teachers using the TEM Evaluation Framework and OASYS software system
- Collaborated with Regional Superintendent, Instructional Leadership Directors, Principals, and Master Teachers to norm and create professional development plans for individual schools
- Provided training, professional development, and support for school administrators

Special Projects Coordinator II - School Improvement *(2008-2013)*

- Wrote grants to provide additional funding for the instructional program
- Monitored school improvement budget (over $1 million)
- Coordinated and presented professional development
- Provided instructional support for new teachers
- Observed and evaluated teachers
- Administered student discipline
- Collected and disaggregated data to track student progress
- Monitored and facilitated action plan for school improvement
- Mentored new teachers

Teacher *(1997-2008)*

- Designed lessons incorporating various instructional strategies to appeal to diverse learners with 95% of students scoring proficient or advanced on state assessment

- Served as departmental chairperson
- Writer and editor of school newsletter

Additional Leadership Experience
- Behavior Event Interview Trainee
- Freshman Academy Lead
- Professional Development Coordinator and Presenter
- Dual Enrollment Coordinator
- What's A Good School (WAGS) Appraisal Coordinator
- AdvancED Chairperson
- School Improvement Component Chairperson
- Testing Coordinator

Professional Development
- Superintendent's Leadership Academy, Memphis, TN
- Standards Institute, Orlando, FL
- Achievement Partners Network – Foundational Skills, Memphis, TN
- Biological Science Curriculum Study – 3-D Instruction, Memphis, TN
- National Science Teachers Association – 3-D Instruction, Memphis, TN
- Model Schools Conference, Washington, D.C.
- Eureka Math Training, Memphis, TN
- Expeditionary Learning Training, Memphis, TN
- Revised Science Standards Training, Jackson, TN,
- Elena Aguilar Instructional Coaching Conference, Miami, FL
- U.S. News STEM Conference, San Diego, CA
- D2D Standards Training, Memphis, TN
- iZone Coaching Institute, Memphis, TN
- Questioning and Understanding to Improve Learning and Thinking (QUILT), Memphis, TN
- High School Redesign and Reform, San Diego, CA