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A Social Network Approach to Diffusion of Educational Technology Integration in the Early Childhood Grades

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Research suggests that integrating educational technology into the classroom can be beneficial for both student socio-emotional and academic outcomes. Particularly when computer-assisted instruction is linked to teacher-led classroom instruction, there is increased evidence of meaningful positive effects (Cheung & Slavin, 2012). However, research also shows that not all efforts at technology integration are successful (Lei, 2010). Factors such as the quality of technology (Lei, 2010; Rashid & Asghar, 2015), the developmentally appropriateness of the technology (Mims-Word, 2012), and the extent of personalization of content (Walkington, 2013) can influence or impede student performance outcomes. The context of the educational environment can compound these factors. Rural schools, by their very nature, are often isolated, have fewer resources, and have limited access to networks and hardware necessary for technology integration (Larwood, 2005; Mueller & Brewer, 2013; Steed et al., 2013). Despite these challenges, some rural schools are successful in implementing high-quality educational technology integration initiatives. The underlying social networks of the rural schools implementing the initiatives may explain this anomaly. The purpose of this qualitative case study was to explore the social network structure of one rural PK-8 school in the Midwest implementing an educational technology integration initiative at the PK level. This study applied diffusion of innovation theory as a lens to answer the research questions.

Research Questions

1. What is the underlying social network structure of the school in this study?
2. What are the teachers' and leaders' perceptions of the social network structure in this school?
3. How, if at all, does the underlying social network structure influence the diffusion and adoption of technology innovations within this school?

Theoretical Framework

Diffusion is defined as "the process by which an innovation is communicated through certain channels over time among the members of a social system" (Rogers, 2003, p. 4). Diffusion of innovation theory views change, then, not as a linear process, but as a cyclical process in which adoption of innovation occurs continuously within an organization (Rogers, 2003). Diffusion of innovation theory has been used as a model in many fields to study the adoption of new ideas (Ashley, 2009; Rogers, 2003) and is increasingly used to analyze the process of change in the field of education. This study applies diffusion of innovation theory to analyze the spread of technology innovations and adoption of practices within a school district.

There are four main elements in the process of diffusion: innovation, communication channels, time, and social systems (Rogers, 2003). Innovation is "an idea, practice, or object perceived as new by an individual or other unit of adoption" (Rogers, 2003, p. 10). The extent to which an individual within the organization perceives the relative advantage of the innovation explains the rate of adoption of the innovation (Rogers, 2003). Communication channels are the pathways by which information about the innovation is exchanged between individuals within the organization (Ashley, 2009; Rogers, 2003). The type and strength of relationship shared by the individuals often determines the success of communication (Ashley, 2009; Rogers, 2003). Time refers to the period between introduction and adoption, the stage in the change process at which the decision to adopt is made, and the rate of adoption of the innovation within the organization (Adams & Jean-Marie, 2010; Rogers, 2003). The social system is the network of individuals, groups, or units working toward a common vision, and the position of individuals within the social system (e.g., change agents, opinion leaders, brokers) can influence change within the system, with these individuals either serving as facilitators of the diffusion or as barriers (Rogers, 2003).

Review of the Literature

The following literature review presents key research and findings related to the benefits of technology integration, early literacy development, digital equity, effectiveness of technology integration, and social networks as facilitators of change.

Benefits of Technology Integration

As schools evaluate how to create environments and experiences which foster learning that prepares students for the future, much of the conversation focuses on the establishment of a 21st Century learning culture (Schrum & Levin, 2015). This desired outcome lends itself to the discussion of how technology-rich environments and experiences can aid in the creation of this type of culture in schools (Schrum & Levin, 2015), and its advancement on early literacy

(Beschorner & Hutchison, 2013). The use of technology in the classroom often referred to as technology integration, has the potential of producing many benefits for students (Beschorner & Hutchison, 2013). Technology integration whether part of the delivery of content or embedded in the overall classroom environment works to engage young learners with the intent of increasing their learning (Kalonde, 2017). Schools that properly integrate technology into their early childhood classroom instructional practices have shown to have a positive impact on early literacy development (Flewitt et al., 2015) digital equity (D'Agostino et al., 2016), and student engagement (Flewitt et al., 2015; Keengwe et al., 2012). These integration practices come in various configurations, with many schools looking to integrate technology devices in 1:1 model (Stone, 2017). These types of 1:1 integration models "provide a personal digital device (e.g., a laptop or a tablet computer) to every student" (Stone, 2017, p. 2282).

Early Literacy Development

The use of technology in early learning is an often-debated topic among parents and experts (Axelsson et al., 2016; Beschorner & Hutchison, 2013; Flewitt et al., 2015) largely due to health and safety recommendations provided by the American Academy of Pediatrics (2018) regarding passive computer use, and screen time for young children. However, schools using technology integrated in such a way that students are actively creating and engaged in the use of technology during the learning process, through proper utilization as recommended by field experts (American Academy of Pediatrics, 2018) have shown to have positive benefits on young learners (Heflin, et al., 2017).

Literacy is defined as the "process of making meaning through reading, writing, and communicating" (Beschorner & Hutchison, 2013, p.18). Students exposed to technology integrated into the literacy content of a classroom experienced positive effects on literacy development, improved was particularly seen in struggling readers (D'Agostino et al., 2016). D'Agostino et al. (2016) and Nelson (2015) discovered that students who struggled with reading benefited greatly from the use of technology integrated into the classroom. Beyond basic literacy skill, the implementation of technology has brought about early awareness to digital literacy development focused "on the ability to properly use, manage, interpret, validate, and synthesize information" (Stone, 2017 p. 2284). D'Agostino et al. (2016) outlined the importance of integrating technology into the classroom as a foundational element of helping the student become more technologically literate.

Digital Equity

For lower-income students, the lack of internet connectivity or technology device, sometimes referenced as the digital divide, the use of technology in the classroom may be students only opportunity for access (D'Agostino et al., 2016). In a review of the literature regarding access to technology for young children, Asselson et al., (2016) reported preschool age children with access to technology at home showed more signs of school readiness. This finding makes the presence of devices in the classroom much more important because of its potential to close the digital divide and inequity of student access (D'Agostino et al., 2016). Stone (2017) demonstrated that students with access to devices benefit from expanded content and material, especially when presented in a 1:1 learning model.

Student Interaction and Engagement

Student engagement and interaction is important in creating a positive learning environment and the use of technology devices in the classroom aids in the cultivations of a collaborative culture (Ensor, 2012; Jahnke & Kumar, 2014) among the students, building a community among young learners. Intentional activities that leverage the use of devices can help students participate in purposeful conversations around what they are learning (Beschorner & Hutchison, 2013). The use of technology in school brings with it a sense of curiosity and excitement (Flewitt et al., 2015). Research by Beschorner & Hutchison (2013) showed evidence that students sought to explore the devices of their peers and enjoyed talking about the applications they used while demonstrating to others how to use the technology. Teachers have reported that students who engage with technology in the classroom demonstrate a higher level of concentration and desire to produce (Flewitt et al., 2015). While technology and school 1:1 models focus on positive outcomes and benefits for students, successful technology implementation falls heavily on teachers, leadership, and school communities.

Ineffective Technology Integration

In 2001, Larry Cuban noted that despite large expenditures devoted to technology implementation in schools across the United States, there was limited usage in classrooms by teachers and students. Further, he contended that technology initiatives and reforms offer an incomplete solution to school improvement. In the nearly two decades since Cuban's book was published, the availability of technology in schools has increased around the globe (OECD, 2015), yet research has found that increased access to technology does not necessarily predicate heightened student achievement (see, for example, Dunleavy & Heinecke, 2007; Fried, 2008; OECD, 2015; Weston & Bain, 2010).

Researchers have concluded that simply putting technology into schools will not produce educational improvement without complimentary changes to instructional practices (Falloon, 2015; OECD, 2015). For example, Peck et al. (2015) noted that technology initiatives may result in teachers use of technology for administrative purposes while a continued reliance on traditional, teacher-centered instructional practices prevail. In other cases, technology integration may be used to assist students in finding information, but does not result in students engaging in deeper levels of thinking or analysis of information (Holen et al., 2017). Further, technology may be used inequitably; Hughes and Read (2018) found students from disadvantaged backgrounds were more likely to use technology to practice basic skills or play games, while more affluent students wore more likely to engage in activities that require higher order thinking. In short, a technology initiative alone does not necessarily improve schools or instruction (Peck et al., 2015).

Research has shown teachers' readiness (Inan & Lowther, 2010), attitudes (Boling, 2008; Straub, 2009), and knowledge of how to integrate technology into their curriculum play a role in effective integration (Boling & Beatty, 2012). Professional development may assist teachers in integrating technology in ways that advances student achievement, but is not always structured effectively. For example, Smith and Coleman (2018) found that teacher support focused on how to use devices rather than on how to incorporate them into student learning goals. Additionally, the timing

of professional development impacts implementation; failing to provide time during the school day for teachers to practice using technology and plan how it will be used in the classroom limits effectiveness (Topper & Lancaster, 2013). Variations in teachers' perceptions of technology and access to effective professional development may explain why teachers use technology in very different ways. In their study of teachers' use of iPads, Liu et al. (2016) found some teachers used the devices in innovative, student-focused ways, while others used them as tools for efficiency without changing instructional practices.

Other challenges to effective technology integration stem from leadership and infrastructure (Vatanartiran & Karadeniz, 2015). For example, a lack of clear communication about the mission, goals, and expectations of technology initiatives may lead to inconsistent implementation and difficulty defining success (Smith & Coleman, 2018; Topper & Lancaster, 2013). Additionally, ensuring teacher buy-in is important in implementing a technology initiative because a top-down approach may lead to teacher and student resistance (Smith & Coleman, 2018). Integration efforts may also be unraveled by ineffective technological infrastructure. Stefl-Mabry et al. (2010) found slow connections and frequent computer crashes contributed to minimized technology use in classrooms. Further, a lack of time to learn how to use devices, maintenance and troubleshooting, and connectivity issues were also challenges identified by educators (Liu et al., 2016). Smith and Coleman (2018) noted that problems with infrastructure also contributed to teachers' resistance to implementation and inability to integrate technology.

In addition to the challenges already mentioned, rural schools may face further roadblocks to technology integration. Wang (2013) notes "many rural areas find themselves still at a disadvantage in terms of access to and the cost of advanced tools and services" (p. 136). Additionally, rural schools tend to have slower bandwidth, which impacts teachers' ability to use internet-based instructional tools (Redding & Walberg, 2012). Lowther et al. (2008) cited lack of access to computers and teachers' knowledge of technology's pedagogical uses as obstacles to implementation in some rural schools. Wang (2013) noted that rural teachers fell behind urban teachers in terms of fully adopting new technology and suggested this may be due to less peer support and more frequent disruptions to access (Wang, 2013). Similar findings noted that rural teachers indicated they had little training or support from their school districts in learning how to integrate technology (Howley et al., 2011; Kalonde, 2017a). Rural students may also have less access to technology in their classrooms (Hughes & Read, 2018; Wang, 2013). Kormos (2018) noted that rural teachers trailed suburban teachers in several measures of technology integration: student access, use of pedagogical and assessment technologies, and communication technologies. The struggle to integrate technology in rural schools is often complicated by state and national educational policies that aim innovation efforts at urban settings without fully considering the needs and challenges present in rural schools (Wang, 2013).

Social Networks Influence Change

Although there are challenges for imbedding quality technology use within rural schools, the underlying social network structure can lend to successful implementation within the practiced pedagogy. Educational leaders can use information from the social network analysis (SNA) to create successful change by leveraging their understanding of communication and interaction

patterns within their organization (Ahuja, 2000; Daly & Finnigan, 2010; De Laat et al., 2007; Tsai & Ghoshal, 1998). Research conducted in 104 schools in the United Kingdom by the National College of School Leadership (NCSL) noted that network connections identified “frequent and pervasive communication, shared understanding and purpose, joint challenging work, and relationships built on trust” (Daly, & Finnigan, 2010, p.114). The SNA resources may be of interest to districts seeking to implement improvements and change in their educational practices (Cross et al., 2002; Song et al., 2007)

Researchers can use SNA to recognize the informal and formal network connections and target individuals that will promote or hinder the innovation process within the organization (Nonaka & Takeuchi, 1995; Quardokus & Henderson, 2015; Uhl-Bien et al., 2007). Density and centrality are SNA properties that contribute to the strengths and weaknesses of network ties (Bryk & Schneider, 2002; Lima, 2010). The density of a network is the actual ties divided by total possible ties within a network (Daly, & Finnigan, 2010; Prell, 2012; Quardokus & Henderson, 2015). Information and resource exchanges in high density networks tend to move more quickly and easily compared to networks of low density (Daly & Finnigan, 2010; Quardokus & Henderson, 2015; Scott, 2000). The smaller faculty size of a rural school can lead to the creation of a community with stronger ties that are built on higher levels of trust needed to implement change (Bryk & Schneider, 2002). Deadlines issued for implementation of innovation and improvements may be met by identifying the high- and low-density networks.

Leaders using the centrality of SNA can determine the disproportionate ratio of information and resources within their organization. Centrality indicates the connections an individual has with other network members (Wasserman & Faust, 1997). The highly centralized individuals have many network links and resources while the less centralized individuals are more disconnected with less resources and information (Burt, 2000; Daly & Finnigan, 2010, Stuart, 1998; Tsai, 2000). The betweenness centrality of an individual defines the potential power or prestige of a network member (Borgatti, 2009; Liu et al., 2011; Raider & Krackhardt, 2001) and alerts innovative leaders to individuals that are hoarding or lacking resources that hinder adoption of innovative educational practices.

In determining the influence of social networks on the adoption of technology innovations, leaders review change strategies to make informed decisions on where dissemination of information and adoption are lacking or succeeding (Wasserman & Faust, 1997). Henderson, Beach, & Finkelstein (2011) identified prescribed and emergent outcomes of change in a meta-analysis of higher-education. Prescribed outcomes of change are introduced to individuals in advance in an effort to motivate adoption of the initiative, while emergent outcomes evolve during the process of change (Henderson et. al., 2011).

Leaders acknowledge the difference between prescribed and emergent outcomes of change and strategically target participants to produce successful outcomes (Quardokus & Henderson, 2015). When there is a prescribed outcome of innovation expectation, reviewing the density of the network provides leaders of change with the individuals and networks demonstrating positive or negative results (Quardokus & Henderson, 2015). Leaders analyzing the emergent outcomes of

change review the SNA to create subgroups that differ in characteristics such as stability, support or creativity (Plowman et al., 2007; Quardokus & Henderson, 2015). Future leaders can use the data from SNA to purposefully target the goals associated with innovation initiatives in education.

Methods

This qualitative case study draws on the methodological approach of social network analysis (SNA) and qualitative methods of interviews, observations, and document review. In the following section, we provide information on context for the study, data collection and analysis methods, and trustworthiness techniques.

Context for the Study

The study was conducted in an independent PK-8 school district in the rural Midwest. The district consists of one school, Easternville Public Schools, which serves PK3-8 students on one campus. The campus consists of one main building which houses grades PK3-5, the cafeteria, the media center, and administrative offices and one separate metal building which houses grades 6-8. Six hundred eighty students attend Easternville. Of these 680 students, 82% identify as American Indian, and 78% qualify for free/reduced lunch. There are approximately 50 staff members employed at the school as well as a superintendent, a part-time district-level administrator, and two site principals.

Purposeful sampling was used to identify the site in this study. The site was selected because of its rural location and its possession of extensive technology resources. Easternville has a history of grant writing success, and through this success has built an indoor play space, provided weekly swim lessons for all students, secured 1:1 technology in the form of MacBooks for all students in grades 6-8 and began a 1:1 iPad initiative with PK3 and PK4 students. This initiative included iPads for all students and staff, on-site technology coaching, monthly professional development, and resources to purchase educational apps and receive additional training outside of the school. At the time of the study, Easternville PK was in its third year of implementation and in the final year of the 1:1 grant funding.

Participant Selection

Purposeful sampling was also used to identify participants for the study. All PK3 and PK4 teachers were asked to participate in the study. Additionally, two site principals, one superintendent, and the district grant writer were asked to participate. Additional participants were recruited through results of the SNA surveys; those participants identified as actors with a proportionally high or low number of ties were also invited to interview. All PK3 and PK4 teachers, eight total, agreed to participate as well as all administrators and the part-time district coordinator. Two additional staff members, a kindergarten teacher and a site coordinator, also agreed to be interviewed.

Data Collection

The data for the study were collected through SNA free-choice surveys, interviews, observations, and document review.

Surveys

Free-choice surveys were administered through Qualtrics to all certified teachers and administrators of the school. Survey questions were guided by the study research questions and relevant literature. On the survey, all participants were asked:

1. Whom do you go to for information or help related to integration of educational technology?

Additionally, PK3 and PK4 teachers were asked the following questions specifically related to the 1:1 initiative:

1. With whom do you share ideas related to technology integration initiatives and strategies?
2. Who has been most influential in your implementation of technology integration initiatives or strategies?
3. If you have a problem related to technology integration initiatives or strategies, to whom do you turn for help?
4. If you need critical information related to technology integration, from whom do you seek this information?

All participants were asked to identify relationships with other staff members within the school and were not limited in the number of responses they could give for each question of the survey (Scott, 2000). A response rate of approximately 70% was achieved district-wide, and for the PK3-4 participants, the response rate was 87%.

Interviews

All PK3-4 staff members and school administrators were invited to interview. Additionally, survey participants identified as isolates, boundary spanners, or actors with a proportional high number of ties were also invited to interview. A total of 14 individuals agreed to participate in the study (See Table 1.) We conducted semi-structured interviews with each of the 14 participants including four PK3 teachers, four PK4 teachers, three administrators, one site coordinator, one kindergarten teacher, and the district coordinator. All 14 participants were asked interview questions related to the formal and informal structures for relationships, perceptions about social structures, and work-related relationships. PK3 and PK4 teachers were asked additional interview questions related to the specific 1:1 technology initiatives including perceptions about sharing of ideas and adoption of the strategies.

Each participant was interviewed one time, and each interview was conducted within the school environment and lasted approximately 60 minutes. Follow up interviews were conducted if clarification was needed. Initial interviews were digitally recorded and transcribed by the researchers.

Table 1. Interview Participants

Name	Position	Grade Level
A174	Teacher	PK3
A125	Teacher	PK3
A166	Teacher	PK4
A136	Teacher	PK4
A118	Teacher	PK3
A103	Teacher	PK4
A141	Teacher	PK3
A161	Teacher	PK4
B134	Principal	
B127	Superintendent	
A170	Principal	
A151	District-Level Admin	
A128	Teacher	K
A156	Coordinator	

Observations

Four researchers conducted observations in early childhood classrooms over a period of four months. Each classroom was observed at least two times during the course of study. Additional observations were conducted during school meetings, trainings, and school events. Each observation lasted between 30 and 90 minutes. Detailed field notes and photographs were collected for all observations and organized using Microsoft OneNote.

Document Review

Additional data were collected from district and site documents related to social networks and integration of educational technology. Documents we examined included demographic and accountability information from the State Department of Education and data related to the implementation and adoption of the technology initiative. These documents included technology coaching notes, professional development follow-up reports from consultants, PLC meeting notes, grade-level technology plans, and individual teacher lesson plans.

Data Analysis

Data analysis was an ongoing process during which analysis of the SNA surveys and analysis of qualitative data overlapped chronologically and occurred simultaneously with data collection.

Survey data was entered into UCINET to create matrices representing the relationships among staff members for each survey question (Borgatti et al., 2002). NetDraw was then used to create visual representations, or sociograms, for each of the eleven matrices (Borgatti, 2002). The resulting sociograms were used to guide interviews and as a qualitative artifact, providing triangulating data for the interviews, observations, and documents.

To analyze the qualitative data, the data were first organized and reviewed for familiarity. The initial coding process (Saldana, 2016) was conducted individually by four researchers. In this

initial phase, open coding of raw data for emerging codes occurred. In the second phase of analysis, the researchers worked collaboratively to review identified codes, identify patterns or categories, and reflectively read the recurring codes to construct themes (Saldana, 2016). In the third phase, data were analyzed against a pre-set list of codes related to the theoretical framework, diffusion of innovation theory. The themes were tested against other data sets.

Trustworthiness

Trustworthiness techniques of peer debriefing, member checking, and triangulation of data sources were employed in this study. Analysis of qualitative data was debriefed within the research team to ensure consistency and accuracy (Saldana & Omasta, 2018) and follow-up questions and interviews were scheduled with interview participants to clarify data and interpretation. Survey results, interview data, observations, and document data were triangulated to ensure reliability and rigor.

Findings

The social network analysis survey resulted in five sociograms, one representing relationships between individuals within the entire district in terms of educational technology and four representing the relationships of PK3-4 teachers in implementing the technology integration strategies. These sociograms revealed patterns of relationships centered on a small number of centralized actors. Participant perceptions support the sociograms reporting a sense of isolation for a number of actors, a network of silos, and strong social influence of a small number of actors. Findings also suggest that leadership plays a key role in development of the social system and the diffusion of innovation.

Social Network of Sparse Ties and Centralized Actors

Sociograms and further findings related to sociograms will be shared during the final presentation.

Perceptions of Social Network

External Isolation

PK3-4 teachers reported feelings of isolation both within the larger school district and within the PK3-4 grade level. Although formal structures are in place for PK3-4 teachers to interact and collaborate with teachers of other grade levels, PK3-4 teachers shared that these meetings were ineffective. Teacher A136 reported,

> We've never had any [districtwide] professional development that I personally felt like pertained to us at all. Yeah, we would go sit through professional development days that we would all just be sitting there staring at each other like, 'What are we even doing here?'

Based on feedback from the PK3-4 teachers, the structure of these early release days was changed for the 2017-2018 school year. During early release time, PK3-4 teachers were given time to work in grade levels while the rest of the district continued to meet in one large group. Though the PK3-4 teachers perceived the professional development offered after the structural change as more applicable, this new structure has further isolated the PK3-4 teachers from their

colleagues teaching other grades within the district. As one PK3-4 teacher shared, “you're going to have to, if you really want to, [meet] face-to-face, you're going to have to go and seek them [other teachers] out.”

Internal Isolation and Silos

PK3-4 teachers also shared feelings of isolation within the grade level. The PK3-4 wing of Easternville is structured into two pods of four classrooms. The two pods are separated by a narrowed entryway, a remnant from a former outside door that was removed in renovation to build the second PK pod. In many ways this physical separation functioned as a boundary line separating the two groups of teachers. PK3-4 teachers reported more frequent interaction with what they referred to as “closet buddies” or those teachers whose classrooms are connected to their own by a storage closet. Several PK3-4 teachers interviewed stated that the only time during the day they had to talk with colleagues was during naptime. During this time, teachers open the doors to the conjoining closet and can have quiet conversations while still being present in the room with the students. According to A136, “your closet buddy is probably really the only person that you really, really have that formal or informal relationship with.” Another teacher, A174 joked that she collaborated more with her closet buddy because communicating with teachers at the other end of the hall was, “too long of a walk.”

Beyond the physical separation of the classrooms, PK3-4 teachers often reported a sense of “us vs. them” when referring to the sense of collegiality and collaboration across this doorway. Data indicated the presence of two to three distinct groups of teachers operating separate from one another within this physical space. As teacher A136 shared, “It’s kinda like you have a clique on that end, and you and have a clique on this end, and it’s obvious. It’s obvious.” Another teacher, A141, shared:

> There are certain colleagues that you can get to know there are certain colleagues that do not want you to get to know them, and we are pretty cliquish. You don’t go down there [points to the other end of the hall]. You just don’t.

Strong Social Influence

Data suggest that a contributing factor to the feelings of isolation and the structure of silos was the presence of strong social influence by a small number of actors within the network. Although all eight PK3-4 teachers at Easternville had five or more years of experience in the district, data from document review, observation, and interview suggested a hierarchical social stratum amongst the eight teachers. The four most veteran teachers were located at one end of the hallway together. These teachers reported that along with working together for years, they often socialized outside of school around their children’s sporting and extracurricular events. The four less experienced teachers were located at the other end of the hall. Although the two groups interacted during observed professional development sessions or during the school day, there was a visible tension. For example, one teacher, A141, reported of grade-level meetings, “I’m not a fan. Just not a fan.” Additionally, A141, was absent both early release days observed by the research team, and attendance records showed that she was regularly absent on those scheduled days. Some of the PK3-4 teachers were willing to share feelings of social pressure. For example, A103 stated:

> Constant, constant negativity. No positive interaction with any of them. And how, do I say this? I don't know how you would say I feel like I'm being looked down on. I can't. I just I just don't want to be around negative people, you know what I mean?
>
> A136 tried to describe the social influence in this way:
>
> They're not as hateful toward me…but they have some issues with some people on this end, and they just kinda be snooty to some people, but I don't let them, I don't pay it as much attention, and I don't like it. I don't like it. I think we should all treat each other the same.

In short, teachers perceived feelings of isolation within not only their district, but their grade level. While factors such as time to meet as a district group, perceived utility of district-wide trainings, and physical space did appear to contribute to the findings of sparse relationships and isolation, the structure of the social systems appeared to be exacerbated by strong social influence by actors within the grade level.

Leadership

Findings also suggest that leadership plays a key role in development of the social system and the diffusion of innovation. The organizational chart of Easternville indicates that this PK-8 district has three official administrators: a superintendent and two site principals. One principal, B134, is officially the head principal of the entire school, but functionally, only supervises the K-8 grades. The other principal, A170, does not have an official supervision structure, but is informally the principal of the PK3-4. Additionally, the district has two unofficial administrators who serve in part-time coordinator roles. While sociograms indicated that PK3-4 teachers did report ties with administrators in the area of technology integration, interview and observation data indicated that these relationships are mostly technical in nature. For example, PK3-4 teachers reported accessing relationships with administrators within the network to acquire apps for the iPads or to schedule technical service for the technology. For example, A118 reported:

> If it's technology, I might even go to B134. Like, we were without our Smartboard for a while, and I kept putting in tickets and tickets and tickets, and I'm like your worst nightmare; I'll bug you till I get it done.

For instructional leadership and information related to the 1:1 initiative, PK3-4 teachers overwhelmingly referred to leadership outside the school and district as the most influential. During the three years of the grant that funded the 1:1 initiative, district leadership hired an outside consulting group to provide professional development, onsite coaching, and support for PK3-4 teachers. These consultants visited the district monthly to provide both district-wide professional development on instructional technology and to provide focused training for PK3-4. In addition, the coaches spent time with each teacher at least once monthly to observe and provide job-embedded support for use of the iPads, apps, and 1:1 strategies.

PK3-4 teachers perceived this leadership as the most impactful in their instruction and implementation of the 1:1 initiatives. For example, A128 stated, “I’ve come to the last two summer trainings where we did [consultant training] and iPad training and stuff, and that’s where I received, you know, the biggest bulk of help.” Additionally, when asked “Who has been most influential in your implementation of technology integration initiatives or strategies?” all PK3-4 teachers interviewed reported the consulting group or individual consults as key influences in their learning, adoption, and use of iPads. In fact, A128, stated, “[the consultants] they’ve been probably the biggest component of me and us [sic] using the technology because they’ve been with us for a while now”. While PK3-4 teachers did have relationships with official district administrators related to technical and transactional needs, data indicated they overwhelmingly turned to outside consultants for pedagogical or instructional assistance.

Diffusion of 1:1 Initiatives

According to the International Society for Technology in Education (ISTE) (Sykora, 2014), 1:1 initiatives give students “access to digital tools throughout the day” and “challenge teachers to rethink and redesign learning activities to capitalize on their schools investment in technology.” Further, ISTE outlines essential conditions for 1:1, specifically that 1:1 should move students from “passive receivers of information to active participants in their own discovery process” (ISTE, 2018) while focusing on student independence and differentiation and personalization of learning. In Easternville, however, data indicate that administrators and teachers across the district define 1:1 in terms of quantifiable measures or how often students physically use devices during the day. According to B127, “even if they have a weak teacher that doesn’t quite understand full implementation and integration of technology, [the students] are going to have [a device] in their hands.” Additionally, administrators and teachers referred to 1:1 instruction in terms of learning how to use educational apps or offering devices as a free choice during center. In fact, the technology plan for the PK3-4 was a list of school weeks on the left side matched with a list of educational games and apps to try for the week on the right side.

Data from interviews indicated that all eight PK3-4 teachers believed that using iPads in the classroom was beneficial for students. A166 shared, “I think that everybody has probably gotten used to using it everyday…I wouldn’t see why it wouldn’t be used because we’ve had training and it’s, it’s so handy.” Additionally, all eight teachers indicated that they were either in the process of adoption of 1:1 or were fully adopted, according to the district definition of 1:1. Overall, teachers were positive regarding the use of iPads and reflected on personal growth since the start of the grant. According to A136, “Oh, we have went from not, from getting these iPads and not even, as teachers, not knowing how to turn them on to creating digital books or QR codes.” Observation data revealed that even though teachers saw the utility of iPads and 1:1 initiatives, devices were most often used for viewing videos on popular apps such as Netflix or YouTube, allowing students to play educational games between teacher-led instruction sessions, scanning QR codes to access eBooks or songs for music, or in large-group discussions such as circle time during which students held iPads and followed teacher-led instruction of shapes, colors, and letters cast to the SmartBoard. There was no evidence of PK3-4 teachers use of technology to target students’ unique instructional needs.

Diffusion of the 1:1 initiative was measured using social network survey, interviews, and consultant notes on use of technology in the PK3-4 and across the district. The social network survey and resulting sociogram showed that few teachers in grades K-8 turned to PK3-4 teachers for information related to technology integration despite the intensive, three-year professional development provided to PK3-4 teachers. Additionally, sociograms show that amongst PK3-4 teachers, information is shared or elicited in isolated networks of PK3-4 colleagues. Interviews and consultant notes supported findings of the social network surveys. PK3-4 teachers indicated that while they might share the names of apps they were using with all colleagues during professional development sessions once a month, when they needed help with technology integration or wanted to share ideas about instructional use of devices, they turned to their small, isolated social network. As A141explained, “three’s here [motions to her end of the hall], fours there [motions to the other end of the hall]…it’s kind of like everyone has their own little…I don’t know how else to say it.”

Consultant notes showed that over the three-year period of the grant, teachers became increasingly more comfortable using technology in the classroom themselves. In the previous school year, some teachers used Book Creator to help students create individual books on colors and animal sounds, but overall, grade-level implementation had not grown beyond the regular use of apps or QR codes. Further, information shared in PK3-4 professional development sessions was reportedly not often shared with staff members beyond PK3-4.

Discussion

In Easternville, the underlying social network structure was comprised of sparse ties and small, isolated networks of teachers with two centralized actors, A141 and A166, as key leaders among two disparate groups in PK3-4. This social network structure appeared to have little influence on teachers’ perceptions of relative advantage of the 1:1 initiative or willingness to adopt strategies. However, the 1:1 initiatives observed were largely technical or focused on entertainment marked by an overreliance on educational apps and games or popular video applications used during scheduled free-choice time. While adoption was reported by most teachers and use of devices was observed, use of technology was largely related to the district reported definition of 1:1 rather than the definition outlined by prominent, national groups such as ISTE.

The underlying social network did appear to contribute or impede diffusion of 1:1 within the grade level and across the district. The lack of connection between PK3-4 teachers and even more sparse connections between PK3-4 teachers and the rest of the district may constrain the flow of information and sharing of ideas. Although the district has invested three years of time and funding into intensive professional development and coaching of PK3-4 teachers on the use of 1:1, there is little evidence that PK3-4 teachers collaborate around this learning or that ideas are shared with the other teachers in the district. The apparent emotional tension between the groups of teachers may compound the distance between networks, eroding trust and instilling fear of sharing among colleagues.

Existing formal structures for communication and leadership do not intentionally facilitate the sharing of ideas among PK3-4 teachers or the district. Findings suggest formal leaders within the

school are not aware of the social structure at the PK level and provide little supervision of instruction or intervention of social problems. These structures, or lack thereof, contribute to the physical and emotional isolation of teachers. Additionally, the reliance on outside consultants for instructional information related to technology integration and 1:1 initiatives indicates potential lack of sustainability. Without internal leadership or formal structures to facilitate the continuous learning and sharing of ideas, there is potential for even current levels of adoption to erode when the grant cycle ends.

The findings illustrate how the underlying social network of a school district can influence the adoption and spread of innovations. Though diffusion of innovation theory is increasingly being used to explore the spread of ideas during periods of change in education, this study suggests social network analysis can be used in conjunction to visualize the movement of ideas. This case shows that, in a rural district, relationships do matter when adopting new ideas. Particularly, relationships are integral to the spread of these ideas between individuals. The implications for practice, then, are that school leaders and policy makers should consider the potential impact of social structures and relationships necessary in fully adopting and diffusing reforms for successful educational change. Additionally, while social structure did not appear to strongly influence individual decision to adopt, social structure played a key role in the spread of ideas across the network.

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