Beginning Science Teachers’ Communications with Families

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Abstract

Science learning occurs in both formal and informal spaces. Families are critical for developing student learning and interest in science because they provide important sources of knowledge, support, and motivation. Two-way communication between teachers and families can be used to build relationships between homes and schools, leverage family knowledge of learners, and create successful environments for science learning that will support both teaching and student learning. Little is known of the capabilities of early career science teachers to communicate with families, but evidence suggests that effective communication is a challenge for them. In this study, communication between first year science teachers and families was examined to determine what methods teachers used to communicate with families, and the types of information that were communicated between teachers and families. Demographic data, interview data, observations and documentation of communication through logs and artifacts were collected from seven first-year science teachers. Results indicated that the methods teachers used for communication impacted the frequency and efficacy of their communication. Teachers and families communicated about a number of important issues, but topics that could improve learning experiences and science futures for their students were rarely discussed, such as advancement in science, student learning in science, or family funds of knowledge. Implications for teacher preparation and induction programs are discussed.

Key words: Beginning science teachers, family-teacher communication
Beginning Science Teachers’ Communications with Families

With continued achievement gaps (Aud, Fox & KewalRamani, 2010) and poor attitudes towards science and science careers in youth subgroups (Osborne, Simon, & Tytler, 2009), science literacy for all students is an educational goal in which we continue to fall short. To improve science teaching and learning, it is important to understand how students learn science and to identify factors that facilitate this learning. From a sociocultural perspective, “looking both within and beyond the classroom” (Lemke, 2001, p. 305) is critical to understanding the different cultural environments in which student science learning occurs. Student success in school science is best supported when there is congruency between these environments (Costa, 1995).

Research has demonstrated the importance of family knowledge, support, and motivation on their children’s learning and interest (Calabrese Barton, Drake, Perez, St. Louis & George, 2004; Gonzalez, Moll & Amanti, 2005). Practices for bridging the home and the classroom are thus critical for developing the next generation of scientists and scientifically literate citizens. However, Rennie (2014) contends that although science is a large part of most children’s activities at home, connections between science at home and at school are rarely made. Shared communication between teachers and families about science learning and student progress is one way to create a knowledge “bridge” between schools and homes in order to support science student learning.

Establishing effective communication with students’ families is a strategy teachers can use to provide learning continuity for students. For instance, research indicates students are more likely to take advanced mathematics and science coursework in high school when families and teachers communicate about course options (Crosnoe, 2009). Other studies demonstrate that
when families and teachers communicate about specific student behaviors, homework completion rates and class participation by students increase (Kraft & Dougherty, 2013). Communication with families, therefore, becomes a source that teachers can use to motivate students.

Developing effective family-teacher communication skills are especially critical for early career teachers because they frequently teach in classrooms that are linguistically, socio-economically, and culturally diverse and different from their own backgrounds (Bransford, Darling-Hammond & LePage, 2005). Teachers’ communication with families has been identified as an essential disposition for effective teachers (Darling-Hammond, 2009) and one of several high leverage teaching practices, in which “the proficient enactment by the teacher is likely to lead to comparatively large advances in student learning” (TeachingWorks, 2014). However, strategies for creating effective family-teacher communication are often omitted from teacher preparation programs; thus, left untaught to teachers (Epstein & Sanders, 2006) and unpracticed.

When beginning science teachers start their first year of teaching they have many new responsibilities to support their students’ learning, including the professional responsibility of communicating with their students’ families. What drives this communication may include national or local teaching standards (Council of Chief State School Officers [CCSSO], 2011), student performance concerns, a need to learn about their new communities and teaching contexts (Feiman-Nemser, 2001; Shulman, 1987), school norms or policies, and/or an understanding of ambitious and equitable teaching practices (Bianchini & Brenner, 2010; Lampert, Boerst, & Graziani, 2011; Lee & Fradd, 1998). However, in all likelihood these beginning teachers are still developing effective communication strategies because the reality of
this induction period is that beginning teachers are “teaching while still learning to teach” (Bianchini, 2012, p. 389; Feiman-Nemser, 2001).

Although research in this area is limited, evidence indicates beginning science teachers often struggle to communicate effectively with families, particularly with families different from their own backgrounds (Bianchini & Brenner, 2010; Bianchini & Cavazos, 2007). By not effectively communicating with families, beginning science teachers may be deficient in an important strategy to leverage student learning and interest in science. Hence, the purpose of this study is to identify the strategies, frequency and content of what first year science teachers communicate with their students’ families.

**Traditional Family Involvement**

The literature describes different ways that families support their children’s science learning. Traditional frameworks of family involvement (Parenting, Communicating, Volunteering, Learning at home, Decision making, Collaborating with the community) (Epstein, 1995), also called family engagement, shape many current school policies. However, critics of these traditional frameworks contend that these are activities designed by schools for parents to do (Calabrese Barton et al., 2004), they may not be aligned with the values in all children’s homes (Baquedano-Lopez, Alexander, & Hernandez, 2013), or they miss the role of parents’ agency, students’ agency and parental expectations/aspirations (Rodriguez, Collins-Parks & Garza, 2013). When families do not participate in school-sponsored programs or activities, stereotypes may develop that families are uninvolved or are not able to support their student’s learning. Stereotypes are particularly prevalent for low-income, single parent, and non-traditional families. The deficit perspective holds that these families are “deficits” for their student’s science learning and science future (Rodriguez & Berryman, 2002). Among other problems with
stereotypes, the deficit perspective does not take into account that families have unique knowledge and abilities that contribute to student learning (Calabrese Barton et al., 2004; González et al., 2005).

**Family Support for Student Science Learning**

The research literature also reveals that families are important sources of cultural knowledge, support, and motivation for students to achieve in science and enter science fields (Brand, Glasson & Green, 2006; Calabrese Barton et al., 2004; González et al., 2005; Hall, Dickerson, Batts, Kauffmann & Bosse; 2011; Rodriguez & Berryman, 2002). For instance, Calabrese Barton and Tan (2009) found student learning improved when the curriculum included culturally relevant knowledge (funds of knowledge) and beliefs held by students from diverse backgrounds. The literature also identified that families need further information about science courses and trajectories to college to help their students advance in science (Hall et al., 2011; Zuniga, Olson & Winter, 2005).

**Supports and Challenges**

The literature identified supports and challenges to the family-teacher relationship, including effective, culturally-appropriate communication strategies (Lawrence-Lightfoot, 2004). However, research indicates beginning science teachers struggle to communicate with families, particularly with families with different cultures from their own (Bianchini & Brenner, 2010; Bianchini & Cavazos, 2007). In their study of development of equitable teaching practices, Bianchini and Cavazos (2007) described the example of one teacher who had a belief in “science for all” and knowledge of the importance of equitable teaching practices, yet still had poor communication skills with families. As a preservice student he had surveyed his Latina students and their parents to learn more about their culture and home life, in order to find a better way to
engage these students. Yet, during his first year teaching, he still was not able to communicate effectively with families of his Latino/a students due to language barriers as well as his perception of differences.

The body of literature in this field underscores the importance of two-way family-teacher communication to promote information exchange about student science interest and learning, about advanced classes and how to access the pipeline to advanced study in science and STEM; information that may not be available for many families, particularly for nondominant groups (Auerbach, 2007; Rodriguez & Berryman, 2002).

**Theoretical Framework**

Sociocultural and situative perspectives are important frameworks for understanding how two-way communication between families and teachers supports student learning. From these perspectives, learning does not reside in the individual, rather learning is “a complex social phenomenon…distributed–stretched over, not divided, among–mind, body, activity and culturally organized settings (which include other actors)” (Lave, 1988, p. 1). From a situated perspective, science reasoning develops not just in the individual in the classroom but also “arises in the context of different practices that involve the use of different artifacts and are organized by different overall motives” (Lave, 1988, p. 1).

Because learning science is a social activity, it is critical to understand the cultural, social, political, and economic contexts in which this learning operates. Lee (1999) examined how children in Florida learned about a historic weather event in their lives, Hurricane Andrew. The author concluded children had their own way of looking at the world that was representative of their cultural and social environments, as well their personal experiences. The children based their understanding of the hurricane on multiple information sources, including their personal
Student learning of science occurs within multiple cultures, including schools and homes. Schools and homes are different cultural systems, with different educational, social, and communicative norms and priorities (Aikenhead, 1996). Negotiating these different environments can be a challenge for students (Brand et al., 2006; Brown, 2004). Success in science depends in large measure on how effectively students can negotiate into the culture of school science (Aikenhead, 2001). Phelan, Davidson and Cao (1991) demonstrated that students’ abilities to move between worlds of family, peer groups, and classrooms had strong implications for their ability to achieve academic success. They developed the Multiple Worlds model to describe how students negotiate boundaries between their different worlds, and Costa, (1995) confirmed this model for school science. She found that students’ success in school science depended upon the congruency between their multiple worlds and their ability to move between these worlds.

Students are more successful in science when they are supported in making the transition between home and school science (Aikenhead, 2001, Costa, 1995), conceptualized as a cultural border crossing (2001). As Driver et al. (1994) state, “Learning science in the classroom involves children entering a new community of discourse, a new culture; the teacher is the often hard-pressed tour guide mediating between children's everyday world and the world of science” (p. 11). When children from cultures very different from the majority cultures study Western
science, the teacher is not just a tour guide, but also a “culture broker” (Jegede & Aikenhead, 1999).

Communication across these worlds is one mechanism to ease transitions for students. Because families hold a tremendous amount of knowledge about students, communication with families about students, family culture, and science learning can help science teachers learn about the individual student and the community. Funds of knowledge that families and communities hold can be used to create learning opportunities that emerge from students’ lives (Lee & Buxton, 2010). For “science education is successful only to the extent that science can find a niche in the cognitive and cultural milieu of students” (Coburn, 1993, p. 57). In social settings, wherein groups construct knowledge together with one another, families, teachers and students collaboratively create a small culture of shared meanings.

The challenges of moving between worlds and negotiating border crossings can also apply to teacher learning. Becoming effective teachers will require successful border crossings into the world of the school and the worlds of students and their families (Brand & Glasson, 2004; O’Connor & Khasnabis, 2014). To be successful at these crossings, teachers will require many formal and informal supports, including two-way communication with families, to learn about their students. Melnick and Meister (2008) found that experienced teachers know the community in which they teach; thus, are more at ease and communicate more readily with families. Experienced teachers have successfully crossed these borders.

**Purpose**

Beginning teachers can use effective two-way communication to build trusting relationships between home and schools, and create successful environments for science learning that will support their teaching and student learning. The purpose of this study was to examine
the communication between first year science teachers and their students’ families in order to
determine what methods teachers used to communicate with families, the frequency of these
communications and the content of these communications. Research questions that guided this
study are:

1. What methods do first-year science teachers use and how often do they use these methods
to communicate with families?
2. What is the content of first-year science teachers’ communications with students’
families?

Methods

This qualitative research was utilized in order to study the phenomena of family-teacher
communication within the social and cultural contexts of the real-life school environment. The
study took place in first-year secondary science teachers’ classrooms in the Southwestern United
States.

Participants

The study population were first-year science teachers who were graduates of an
undergraduate level or a graduate level secondary science and mathematics teacher preparation
program at a public university in the rural Southwest. At this university, the undergraduate
teacher preparation program is a replication site of the UTeach program, developed at the
University of Texas at Austin in 1998, and currently replicated at over 40 universities nation-
wide. Students in the program earn a Bachelor of Science degree in a specific science major or a
mathematics major jointly with secondary teaching certification, and have extensive field
experiences in the K-12 classroom. The Master’s program is designed for students who already
have an undergraduate degree with strong preparation in the sciences, and are seeking secondary teacher certification for teaching in grades 7-12 and an endorsement in a science field.

Because the focus of the study was on the experiences of first-year secondary science teachers, prospective teachers who had recently completed the teacher preparation program were targeted for recruitment. Recruitment was conducted through announcements at a bi-weekly seminar taken in conjunction with student teaching, and emails sent out by program faculty to all recent graduates of the programs, which were comprised of twenty-one females and six males.

Initial criteria were that participants had graduated from secondary science teacher preparation programs in the previous two semesters, had not yet been a teacher of record in a science classroom, had secured a placement for the upcoming school year as a secondary science teacher, and agreed to participate in the study. The second criteria for inclusion in the study was the willingness of participants’ school administration to allow the school to be the site of the research study. Seven individuals who met the criteria were selected to participate in the study. These were all females in their 20’s who were in their first semester of teaching science to secondary students in public school classrooms in the Southwestern United States. Six teachers self-identified as white and one teacher (Ms. Eclipse) self-identified as Hispanic. For confidentiality, teachers are identified by pseudonyms: Ms. Eclipse, Ms. Builder, Ms. Aspen, Ms. Heart, Ms. Matter, Ms. Atom and Ms. Stone.

**Context**

Demographics and select school indicators of the participants’ schools are presented in Table 1. Two of the teachers taught science at middle school and five taught science at high school. Five of the teachers taught in schools designated low-income by the U.S. Department of Education and two of the teachers taught in schools without this designation. Although much lower than the
state average of 44%, Latino/Hispanics made up a significant minority (21-24%) in six of the schools, comparable to the national average of 24% (Fry & Hugo Lopez, 2012). The seventh school had a Latino/Hispanic population slightly lower (42%) than the state average of 44%. At the school level, all schools but one were at the same academic level as the state or better based on the state assigned school report card, all had a similar or higher graduation rate than the state, and all had a similar or higher passing rate than the state average on the state science standardized test.

Table 1

Demographics of students in the school districts and select school indicators

<table>
<thead>
<tr>
<th>Teacher</th>
<th>School level</th>
<th>White (%)(^\text{a})</th>
<th>Native American (%)(^\text{a})</th>
<th>Hispanic or Latino (%)(^{b})</th>
<th>Low income (%)(^{c})</th>
<th>School report card rating(^d)</th>
<th>Pass rate on state science test (%)(^{e})</th>
<th>Graduation rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ms. Eclipse</td>
<td>Middle</td>
<td>68.9</td>
<td>0.6</td>
<td>24.0</td>
<td>Y (63)</td>
<td>C</td>
<td>61</td>
<td>N/A</td>
</tr>
<tr>
<td>Ms. Aspen</td>
<td>High</td>
<td>43.6</td>
<td>5.9</td>
<td>40.2</td>
<td>Y (57)</td>
<td>C</td>
<td>38</td>
<td>75</td>
</tr>
<tr>
<td>Ms. Builder</td>
<td>Middle</td>
<td>50.0</td>
<td>19.5</td>
<td>22.0</td>
<td>Y (49)</td>
<td>B</td>
<td>64</td>
<td>N/A</td>
</tr>
<tr>
<td>Ms. Matter</td>
<td>High</td>
<td>63.7</td>
<td>0.8</td>
<td>21.4</td>
<td>---</td>
<td>A</td>
<td>67</td>
<td>92</td>
</tr>
<tr>
<td>Ms. Heart</td>
<td>High</td>
<td>70.0</td>
<td>0.1</td>
<td>23.0</td>
<td>---</td>
<td>B</td>
<td>56</td>
<td>90</td>
</tr>
<tr>
<td>Ms. Atom</td>
<td>High</td>
<td>50.0</td>
<td>19.5</td>
<td>22.0</td>
<td>Y (36)</td>
<td>C</td>
<td>42</td>
<td>78</td>
</tr>
<tr>
<td>Ms. Stone</td>
<td>High</td>
<td>71.0</td>
<td>0.7</td>
<td>24.2</td>
<td>Y (47)</td>
<td>B</td>
<td>59</td>
<td>84</td>
</tr>
<tr>
<td>Arizona</td>
<td>High</td>
<td>41.0</td>
<td>5.0</td>
<td>44.0</td>
<td>51</td>
<td>B</td>
<td>63 MS/40 HS</td>
<td>76</td>
</tr>
</tbody>
</table>

Note. The US Census consider those of Hispanic/Latino descent an ethnic group and not a racial group.
\(^{a}\) US Department of Education (2012), American Community Survey, 2008-2012. These data represent those who reported a single-race and did not indicate they were Hispanic or Latino.\(^{b}\) These data are for those who reported Hispanic or Latino regardless of race.\(^{c}\) Low-income as defined by the US Department of Education. Source: U.S. Department of Education (2012).\(^{d}\) Source: Arizona Department of Education (2015). In 2014 65% of schools statewide got an A or B.\(^{e}\) 2013-2014 scores on the state science test. The middle school test is given in 8th grade, the high school test after students have taken life science, typically 10th grade.\(^{f}\) In the magnet program in which Ms. Builder taught, unlike the school district in which she worked, the percentage of students of Hispanic/Latino or Native American descent was less than 10%.

**Data collection**

The study was conducted over the course of the teachers’ first semester in the classroom. The researcher collected data from the teacher participants at four time periods: before the semester began, one month into the school year, the middle of the first semester, and the end of
the first semester. Interviews, communication logs, questionnaires, artifacts, and observation of school activities formed the basis of the data to document strategies beginning teachers used to communicate with families and the content of these communications.

Both methodological and source triangulation were used in this study to establish credibility of the research findings. Frequent interaction with the study participants at interviews, direct observations of communications with families at open house events, member checking and method triangulation established credibility. Detailed field notes and researcher triangulation of a sample of data analysis established dependability and confirmability (Guba & Lincoln, 1994).

**Interviews.** Semi-structured interviews with teacher participants were conducted at three time periods: directly before the semester began, one month into the school year, and the middle of the first semester. The interview protocol for teacher participants was modified from protocols used by Friedrichsen, Chval & Teuscher (2007) and Gainsburg (2012), in which beginning teachers were asked to describe use of teaching strategies. The initial interview was about the participants’ background, experience in student teaching, teaching philosophy, and plans for communicating with families. At this first interview, the researcher also described how to collect artifacts of communication. During subsequent interviews, the interview questions were structured around the experiences with communicating with families using the artifacts of communication and the communication log information as the basis for the discussion.

**Artifacts of communication.** Because many communications with families could not be directly observed in this study, artifacts of communication were collected to document evidence of teacher’s use of communication strategies. Examples of artifacts included family letters, syllabi, group e-mail messages, and website posts that teachers created to communicate with
families. Artifacts of communication were collected one month into the school year, the middle of the first semester, and the end of the first semester.

**Communication logs.** A communication log was provided to each teacher participant to document each instance of formal and informal communication (including verbal messages) between the teacher and students’ families, including emails, phone calls, meetings, conferences etc. Communication logs were collected one month into the school year, the middle of the first semester, and the end of the first semester.

**Observations.** The researcher conducted observations as a non-participant observer (Creswell, 2003). Observations were conducted at open house events within the first month of the school year, in order to observe in-person instances of family-teacher communication for a subset (n=3, 42%) of the participants.

**Questionnaires.** The researcher used an electronic questionnaire to collect data from teacher participants at the end of the semester. This questionnaire contained questions modeled from the interview protocol and queried teachers about recent communications with families since the last interview, any changes in communication strategies or content, and for a summary of their experiences communicating with families over the course of the semester. Electronic questionnaires were also used to collect information from cooperating teachers and mentor teachers at school sites one time during the study. Questionnaires with these teachers were used to confirm the practices the first year teachers reported they used communicate with families in order to triangulate findings.

**Data Analysis**

To answer research question number one (What methods do first-year science teachers use and how often do they use these methods to communicate with families?), frequency counts
from communication logs, artifact portfolios, interviews, and observations were used to quantify strategies that teachers utilized and the frequency of their use. In order to answer research question number two (What is the content of first-year science teachers’ communications with students’ families?), the content of the communications from artifacts, observations, and interviews were analyzed using modified analytic induction (Bogdan & Biklen, 2006) and the constant comparative method (Strauss & Corbin, 1998), as described by Saka, Southerland & Brooks (2009) and Saka, Southerland, Kittleson & Hutner (2013), in their studies of beginning science teachers’ transitions into teaching. From the research literature, a conceptual framework for family-teacher communication was developed and formed the basis for the analysis. The framework included categories representing research-based ways that families and teachers work together to support student learning, including communication to: a) request resources/ funds of knowledge from families and the larger community (Calabrese Barton & Tan, 2009; González et al., 2005), b) invite families to participate in the school community (CCSSO, 2011), c) share information about student progress (Danielson, 2007), d) discuss the needs, abilities, and interests of individual students (Danielson, 2007), e) respect family beliefs, norms and expectations and seek input from families when making decisions (CCSSO, 2011), f) share information about the science instructional program and instructional strategies (Danielson, 2007; Henderson & Mapp, 2002), and g) discuss aspirations that students and families have about advanced courses and careers in science (Auerbach, 2007; Henderson & Mapp, 2002; Rodriguez & Berryman, 2002). Each individual communication was coded based on this framework. Data that did not hold up to the framework led to a modification or refinement of the framework, with new categories and codes added, deleted or modified.
Results

The purpose of the study was to investigate the methods teachers used and the content of their communications with families.

Methods Used for Communication

Identification of methods for communicating with families demonstrated that teachers utilized both individual communications (phone calls, emails, conferences) and group communications (syllabi, website, class emails, class letters, back-to-school night/open house, Flip Day), through both web-based and non-web-based formats. Methods that each of the seven teachers used to communicate with individual families and the number of individual contacts are presented in Figure 1. A wide range of different methods was used over the course of the semester.

![Figure 1. Teachers' individual communications with families.](image)

There were large variations in how often individual teachers communicated with families, from fewer than 10 individual contacts over the semester to more than 60 individual contacts.
**Paper methods.** Teachers used paper methods infrequently. In their initial interview (before the semester began), three teachers were very excited about sending out good news postcards or newsletters, but only two teachers had sent out one postcard each by the end of the first semester.

**Phone calls.** Phone calls were rarely utilized by teachers to communicate with families. Phone calls were the preferred method of only one teacher, Ms. Heart, whose school also required phone calls for the initial contact with families. Other teachers identified reasons for not using phone calls, such as challenges conveying effective messages, inability to maintain a “paper trail” of communication, or challenges contacting families by phone.

**In-person.** Teachers had a limited number of opportunities to communicate in-person with families. These opportunities were primarily family-teacher conferences or open houses, and not all schools held these activities because of scheduling or other issues. Before these events, several teachers were told by other teachers at their schools that attendance would be poor at these events. Thus, Ms. Matter was surprised when 26 families attended the Open House. “Everybody else that I talked to was like, ‘nobody shows up to these things, we are just going to sit in our classroom and not do anything’” (Ms. Matter). Ms. Atom was caught unprepared when family members attended the event after other teachers told her about poor participation by families at the school. “I...kind of walked in with no plan because they were like, ‘don’t expect anyone to show up’” (Ms. Atom).

Conferences were another opportunity to communicate with families in person. Ms. Aspen learned a lot about the community from this experience.

A lot of the families that came to the parent teacher conference, I noticed that they're really pushing their children to take school seriously. . . . I really think that the whole
community as a sense wants the children to get a better education and pursue their own dreams and get better jobs (Ms. Aspen).

In-person communication methods were primarily organized by schools, not teachers. Ms. Aspen was an exception. Although her school had no open house at the beginning of the school year, she invited families as chaperones on field trips and used this opportunity to talk with families about the science program. Two other teachers, Ms. Builder and Ms. Eclipse, described in the initial interview that they had planned for families to be invited into the classroom to view the student projects, but ultimately these teachers did not hold such events during the semester.

Web-based methods. Teachers used a variety of web based methods to communicate with families, including on-line gradebooks, individual emails, group emails, web-sites and web-based texting services. According to the teachers, web-based methods provided many advantages for teachers and families, including speed, documentation, and opportunities for real-time grade and assignment checks. Four teachers learned early in the semester that some of their students’ families did not have computers at home or regular access to web-based communication. They described that this was due to by financial constraints, off-the-grid home location, or students residing with grandparents who were not as technologically savvy. Nevertheless two of these teachers used web-based communication primarily, and two did not. Another teacher learned late in the semester that one boy did not have a computer at home when the mother contacted her about finding an alternative to the on-line textbook.

Content of Communications

As described previously, first year science teachers utilized both individual communications and group communications. Because of the nature and purpose of these
communications, the content of individual communications between teachers and families were coded separately from group communications.

**Individual communications.** Conferences, phone calls, emails, and informal communication with chaperones on field trips were used for teachers and families to communicate individually about students. Analysis of the content of these individual communications revealed themes that identified what was communicated between teachers and families (Table 2). Teachers communicated most with individual families to inform them about student performance. Families and teachers also communicated about classroom procedures and to share information about students. Of the 523 coded instances of communication by the seven teachers over the five month semester (Table 2), 229 (44%) were teachers informing families about student performance, 124 (24%) were relaying classroom procedures, and 133 (25%) were coded as sharing information about student learning or student needs. Of the remaining coded instances, 15 (3%) were about the science instructional program or science learning and 19 (4%) were opportunities for teachers to form relationships with families (greeting, meeting, thanking). There was only one coded instance of discussing student advancement in science, two instances of teachers eliciting funds of knowledge, and no instances of invitations to participate in the program or communication about topics controversial in science classes.

Table 2

<table>
<thead>
<tr>
<th>Code</th>
<th>Sub-code</th>
<th>Instances</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Informing about student</td>
<td>Routine performance</td>
<td>130</td>
<td>43.8</td>
</tr>
<tr>
<td>performance</td>
<td>Failing performance</td>
<td>62</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Positive performance</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>Procedures of the classroom</td>
<td>Missing assignments, absences, make-up work</td>
<td>124</td>
<td>23.7</td>
</tr>
<tr>
<td></td>
<td>Request resources</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>
**Communication about student performance.** Teachers informed families of routine performance (130 instances), challenging performance (62 instances) and positive performance (37 instances). Often, these communications were intended to inform the family of performance concerns in order to instigate a change in behavior or performance. For example, in an interview Ms. Matter described, “We have a problem child, and you send an e-mail home and then the next day they have an apology note and they're ready to sit down and go. You're like okay obviously something happened” (Ms. Matter). Teachers also used email or phone calls to communicate reports of progress, informing families of missing work or failing grades. For instance, Ms. Matter commented, “And anybody who had a D or an F we had to send an email home, saying your student is failing, sign up for a conference if you would like to meet with me” (Ms. Matter).

Some teachers used individual communications to provide messages about positive student performance. As the semester wrapped-up, Ms. Stone sent out 22 emails to students who scored high on the exam: “I sent out one to one of the students in my second hour. She got 100%, so I sent an email to her Mom, and let her know. And I did get feedback…which was nice, she was very pleased” (Ms. Stone). Ms. Heart made a phone call home when a student turns around her previously poor class performance and attitude, “Her mom said, it's nice to get a positive phone
call and not get, you know, something that she's doing something wrong or she's not showing up to class” (Ms. Heart).

The response of families to these communications were mostly positive. After Ms. Heart phoned the family of a poorly performing student, “the parent said he would make sure the student would be in for achievement hour to improve his grade” (Ms. Heart). In another instance, she described,

A parent called me back and we discussed her son’s effort and participation in class. She asked me to send her a list of all the missing assignments and any supporting documents. She also asked me to let her know when he turns in the assignments so that she could monitor him if needed (Ms. Heart).

About 30% of the time, there was no direct family response to the communication and about 9% of the time, the families responded but were not supportive.

**Communicating about classroom procedures.** About one-quarter (24%) of the time teacher communications were relaying/responding to requests for classroom procedural information, such as information about make-up work, how to use the on-line gradebook, or setting up conferences or meetings.

**Communicating about the science instructional program.** Less than 10% of the time individual communications between teachers and families were about student experiences in science class or science learning, as most discussions of science learning occurred at back-to-school night or open houses. Uniquely, by using family members as chaperones on a field trip, Ms. Aspen had an opportunity to have in depth discussions about how she facilitated science learning, “about what we were actually doing in the class” (Ms. Aspen).
**Sharing information.** About one-quarter of the time (25%) communication involved the teacher and family member sharing information about student learning or how to help a student. Ms. Atom said: “I was made more aware of the techniques that work best for this student and the things that interest them to keep this students engaged” (Ms. Atom). Ms. Matter described:

For my F student I had all of his missing work and we created a contract that said when he was going to have all of his work done by. And mom wanted an email every time he turned something in, we all signed it, I made copies of it (Ms. Matter).

Ms. Heart initiated contact when she was concerned about a student:

And I contacted her mother with, you know, ‘She's failing, we've got to get this going.’ And then her mom's like, ‘OK, we'll work on it.’ And ever since she came back from fall break, it's like a switch was flipped. It's like a total 180 (Ms. Heart).

Ms. Builder made extra effort to communicate with students with IEPs. “I always make sure to call those parents, depending upon what [the student] issue is, just to let the parents know … what is going on…if we have an exam or especially quiz weeks” (Ms. Builder).

Communications were also about student interests or needs. Ms. Eclipse commented, “Talking to parents, they can sometimes give you more of an insight as to why their child acts the way that they do, or why they struggle with certain things” (Ms. Eclipse). Ms. Aspen commented about conferences:

I got to talk with them and see where the students are coming from and their perspective and what they have to do at home, like what dealings they have to do at home. So it kind of opened my eyes that maybe this is why this kid might be tired in the morning (Ms. Aspen).
Group communications. Group communications revealed that teachers were often communicating with families about issues they judged appropriate for the group context (Table 3). Six of the seven teachers described the science program in general terms at an open house and three teachers described advancement in science in the syllabi or during the open house. There was little discussion of careers in science through these venues.

Table 3

<table>
<thead>
<tr>
<th>Content of Group Communications</th>
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<tbody>
<tr>
<td>Code</td>
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<td>Class policies/ supplies</td>
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<td>Science program</td>
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<td>Welcome</td>
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<td>Accountability</td>
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<td>Safety</td>
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<tr>
<td>Advancement in science</td>
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<td>Project/ test information</td>
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<tr>
<td>Family involvement</td>
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<td>Family communication</td>
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<tr>
<td>Invitation to participate</td>
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Source of learning family-teacher communication. During interviews, teachers were asked how they learned the communication methods that they had listed on their logs. They described a variety of ways that they learned to communicate with families, including both preservice and inservice teaching and learning environments, personal histories, informal
supports and experiences with their students’ families as the semester progressed. Four of the
seven teachers identified learning about family communication during their preservice programs,
but described that they had no opportunities to practice such strategies as phone calls or in-
person discussions during coursework. Although all had opportunities to communicate with
families during student teaching, the breadth and depth of these experiences were highly
dependent upon the assigned mentor and student teaching supervisor. Ms. Atom commented
about her experience, “A lot of teachers go into student teaching and have never had to contact
parents and don't feel very comfortable with it. [My cooperating teacher] said, ‘I'm throwing you
in the deep end. You're doing all the parent communication’” (Ms. Atom). Funds of knowledge
was not identified as an area in the teachers’ science teacher preparation coursework.

Discussion

The goal of this study was to determine the strategies, frequency and content of
beginning science teachers’ communications with families in order to determine if there were
opportunities to bridge home and school to support science student learning.

Communication Methods

Results demonstrated that teachers differed in how they communicated and how much
they communicated with families. Teachers used paper methods and phone calls infrequently and
had few opportunities to communicate in-person with families. A number of the new teachers
attempted to use a wider range of methods to communicate with families, but at times they did
not always carry out their intentions. The limited use of these methods by most of the teachers
may be due to lack of experience and opportunities to practice these methods during pre-service
and student teaching. Limited opportunity to practice communication methods during their
preservice programs run counter to the work of Ball and Forzani (2009), who argued that the
core of the preservice teacher curriculum should be to practice the strategies teachers are expected to utilize.

In-person communication allowed for some of the richest opportunities for these teachers to interact with families, yet opportunities were limited by time, scheduling conflicts, or poor perceived value of the activity. A perception persisted that family-participation in school events was low. However, when events were held, many of these teachers identified that family turnout was higher than expected. In Kim’s (2009) review of the literature about barriers to minority parents’ participation in schools, she identified that not just individual barriers prevented family participation, but also barriers at the school level, including school friendliness, school policies and leadership. Although there may be challenges to increasing participation at school-based events for both minority and majority families, there also may be opportunities to modify the school climate to promote participation. For instance, Hoover-Dempsey et al. (2005) identified that invitations from schools, teachers, and students were important motivators of families’ decisions to get involved, and the overall school climate was critical for involvement.

Methods that teachers did use to communicate with families were primarily web-based, and in English only. Web-based methods provided many advantages for teachers and families, including speed, documentation, and opportunities for real-time grade and assignment checks. However, the pervasive use of web-based communication also had a strong potential for a lack of equity in reaching the families of all students. A Recent Pew study (2013) demonstrated that there are still big differences in technology availability in U.S. society, with age, educational attainment and income correlated with home broadband access. According to these studies, 70% of Americans over 18 have a high speed broadband connection at home, and 58% of adults own a smartphone, considered an alternate form of “home” internet access (Pew Research Center,
2013). Therefore, up to 30% of families may not have consistent access to teachers’ web-based communications. The numbers identify a wider access issue when looking at the demographics of certain groups that make up many families in schools. Compared with 93% of college-graduates, only 70% of high school graduates and only 52% of those without a high school diploma have broadband access at home or through smart phones. Seventy-five percent of Hispanics and 67% of low income families (below $30,000 per year) have broadband access at home or through cell phones. Forty-six percent of seniors own a smartphone or have broadband access at home (Pew Research Center, 2013).

It is likely that by relying on web-based forms of communication, teachers were not connecting with all of their students’ families, particularly at schools with low socioeconomic status. As Darling-Hammond, Zielezinski & Goldman (2014) described:

On nearly every indicator of educational access—school funding, qualified teachers, high-quality curriculum, books, materials, and computers—low income students and students of color have less access than white and affluent students. (p.2)

For families without web-access, lack of opportunities to receive communications is another example of unequal educational access for low income students and students of color. As we continue to find ways to reduce achievement and attainment gaps in science, technology, engineering, and math disciplines that are prevalent in underrepresented groups (Crisp, Nora & Taggart, 2009), further evidence of unequal educational access is troubling. Teachers in this study identified that technology for communication was changing rapidly, and social media was being considered as an option for future communication. Use of social media may be another way to connect with families, but extensive use of this method may also further exacerbate the ability to reach all families.
There was little evidence that culturally and linguistically appropriate strategies for ELL family communication were used in any of the methods that teachers utilized. All written communications that teachers sent out were in English only. Teachers had varied access to resources for families of ELL students. For some teachers translation support was available, for other teachers, students acted as translators between teachers and family members. Bianchini and Cavazos (2007) identified that first year teachers often were unaware of resources to support ELL students and their families. According to the teachers in this study, most of these schools did not have high ELL populations, so it is unclear how their English-only communications would have differed in other school contexts. Regardless of initial teaching contexts, it is important for beginning science teachers to be aware of the importance of bilingual communications and other resources available to support their student populations.

There were large variations in how often individual teachers communicated with families. When looking across communications between teachers and families, several of the teachers had fewer individual contacts with family members (Figure 1). With no easy alternative to using web-based communication, teachers in some school populations had fewer options to contact families. The methods available for communication appeared to have impacted the frequency of how much they communicated. Choice and access to communication methods may have limited teachers’ abilities to reach all families. Therefore, beginning science teachers need more familiarity with the importance of frequent communications with families and mainstream as well as alternative strategies for communicating with the families in their communities.

**Communication content**

Findings indicated that teachers communicated with families about a number of topics, but did not communicate about some topics important to support student science learning.
Analysis of the content of the communication revealed teachers communicated with families rarely about the science instructional program, science learning, funds of knowledge, or student advancement in science.

Research shows that opportunities to build or share interest in science with families are important, as families are critical contributors to students’ beliefs and values (Jacobs & Bleeker, 2004). The literature identifies many ways that families support student science learning and science futures, including encouragement of students in science (Stake & Mares, 2005), building confidence (Brand et al., 2006), and corroborating a student’s identity as a scientist (Hazari, Sonnert, Sadler & Shanahan, 2010). However, these beginning teachers took few opportunities to communicate with families about science or science learning. By the semester’s end neither had teachers invited families of students to share their science knowledge or work to further this connection in other ways. Although this may be an ambitious goal for new teachers, capitalizing on opportunities to build upon families’ support for science should be an important future goal.

That there were few examples of discussing careers or advancement in science with families was surprising considering the upper grade levels of a number of participants’ students, the age when students apply for college and/or plan their futures. Research indicates families have a strong influence on students’ selection of majors and careers (Hall et al., 2011; Harackwicz, et al., 2012). Teachers and schools have the opportunity to mentor their students into science futures. By not creating this dialogue with families, teachers, schools, and society are losing a valuable opportunity to connect with families to support students’ excitement and awareness of science futures. Capitalizing on opportunities to build upon families’ support for advancement in science should be emphasized to new teachers and in teacher preparation programs.
Although teachers have an important role to support successful border crossings into school science (Aikenhead, 2001), there were few instances in which teachers and families communicated about family funds of knowledge or other topics that would connect students’ home and school cultures. By not utilizing family-teacher communication as the bridge between these two worlds, teachers are losing this important strategy to build student interest and achievement in science.

**Limitations**

This exploratory study had several limitations that affected the analysis and interpretation of the data. One potential limitation was reactivity (Patton, 2002), also called the Hawthorne effect, which is the effect the researcher has on the study participants. In order to collect relevant artifacts, the researcher identified artifacts representing family teacher communication to the participants at the beginning of the study. Therefore, participants may have been more aware of methods for family-teacher communication than non-participants and may have altered their behavior accordingly. Concerns over the reactive effect were reduced by the long-term nature of the study, allowing time for the participant to revert to typical behaviors.

Another limitation in the research was participant self-selection. Of the seven participants, all were women, with no men expressing interest in participating. At the beginning of the study several participants commented they wanted to join the study because they perceived personal weaknesses in the area of family-teacher communication, and wanted to learn more about the topic. Therefore, teachers in this study may have been more prone to self-reflection and had a stronger interest in their personal development than the average first year science teacher. This may also mean that teachers in this study may have communicated more with families than the average first year science teacher. Future research should work to identify the breadth of
communication across larger groups of first-year teachers and the influence of specific pre-service interventions about communication on their later teaching behaviors.

**Conclusion**

Improving student science learning, interest and advancement in science is a challenging, but critical, undertaking to promote equitable opportunities and human progress in solving current and future societal problems. Both the empirical and theoretical research identifies that family-teacher communication supports student learning in science. For instance, the Multiple Worlds model (Phelan et al., 1991; Costa, 1995) contends that success in school science depends upon the congruency between students’ multiple worlds of family, peer groups, and the classroom, and their ability to move between these worlds. Because families hold a tremendous amount of knowledge about students, sharing information about students with families is one method to provide this congruency and can assist students into the world of science, conceptualized as a cultural border crossing (Aikenhead, 2001). In the social settings of school, it is critical that families, teachers, and students work together to create a small culture of shared meanings to help guide students on their journey of science learning. The results from this study indicate that teachers were missing out on important opportunities to communicate with families, especially about school science. Without these communications, there are few opportunities for families and teachers to work together to support successful border crossings into school science.

It was evident that all first year science teachers in this study needed more preparation and support to continue to develop and effectively communicate with families. Thus, this study has a number of implications for teacher educators who focus on pre-service and induction years, to further develop teachers and achieve a vision for effective communication. Explicit
opportunities to learn the importance of and practice family-teacher communication during both preservice preparation coursework and student teaching are important for teachers to practice methods in supportive environments. Instruction about family communication should include introduction to different methods for communication, and familiarity with a variety of methods that are appropriate for different communities. Opportunities to practice strategies with different populations could be emphasized through role playing scenarios that may come up in their teaching environments. Utilizing cases about different scenarios using different communication methods during preservice teaching was suggested by one teacher in this study as a strategy to learn about family-teacher communication. Learning about family funds of knowledge in order to make connections with students in science lessons could be interwoven in science education classes. As ELL and other special needs student populations continue to grow, preservice teachers need more opportunities to consider how to connect with and make science relevant to the lives of their students’ and their students’ families’.

Since research indicates that teachers continue to grow and improve throughout their induction years (Rivkin et al., 2005), our job as science teacher educators should not stop when students graduate. Preparation programs can help developing teachers by offering induction/coaching to those we know are going into the most challenged schools. This mentoring should include content specific support in addition to learning about how to communicate with families in culturally appropriate ways. Preparation programs can also offer continuing professional learning in the form of workshops on special topics such as family communication. They can also continue to inform our graduates through newsletters, web posts, and other forms of networking about current research and provide local and professional learning opportunities for them to continue to develop as teachers. Science teacher educators can also contribute by
developing tools to support first year teachers. These tools may include scripts for how to engage in challenging conversations, and how to set up engaging science open house materials.

Bianchini and Cavazos (2007) describe the importance of providing beginning teachers “site-specific tools” (p. 607), which can include knowledge of resources and opportunities to communicate with families in the new school community. These and other strategies are important first steps to support early career science teachers as they learn to communicate with their students’ families.
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