LESSON STUDY AS AN INDUCTION TOOL FOR NOVICE TEACHERS' PERFORMANCE

by

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"It is somewhat surprising and discouraging how little attention has been paid to the intimate nature of teaching and school learning in the debates on education that have raged over the past decade. These debates have been so focused on performance and standards that they have mostly overlooked the means by which teachers and pupils alike go about their business in real-life classroom – how teacher teach and how pupils learn" (Bruner, 1996).

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ABSTRACT

LESSON STUDY AS AN INDUCTION TOOL FOR NOVICE TEACHERS' PERFORMANCE

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The purpose of this study is (a) to examine the role of the lesson study as an induction program that would promote retentions for novice teachers through structured learning-communities, and (b) to explore the elements of the lesson study that made a positive impression on novices and experienced teachers. A mixed methods design was used to explore the following research questions: Are there any differences between experienced and novice teachers' perceptions of professional learning, collegial learning effectiveness, expectations for student achievement, and their ability to promoting student thinking?; and What elements of the lesson study process and what types of interactions that occur between novice and experienced teachers over the course of the lesson study cycle contributed to the learning and personal growth of the teachers? Teachers were asked to respond to a number of surveys regarding their perceived collegial learning effectiveness; expectations for student achievement; and using and promoting student

thinking. Teachers' written reflections and videotapes documenting the lesson study meetings of two groups of mixed teachers – novices and experienced – were collected. Results showed no statistically significant differences between the novices and experienced teachers in all variables. A qualitative analysis of the videotapes revealed that the elements of the lesson study that might have affected the two groups were the dynamics between teachers in the groups and the learning opportunities for both novice and experienced teachers. These findings suggest that both novice and experienced teachers may benefit from the lesson study process. Limitations and educational implications are discussed.

INTRODUCTION

Mathematics Teaching and Achievement

In the past years, major curriculum reform projects have been launched by the federal government, aiming to promote students' problem solving skills and higher-order thinking development (Darling-Hammond, 1995). These attempts, however, have been immensely difficult to come to their full potential (Darling-Hammond, 1995). Despite the beliefs that they are implementing new strategies and current ideas of teaching, teachers continue to endorse rote-teaching without real change in the way they do mathematics (Hiebert & Stigler, 2000) and thus highly visible and well intentional efforts missed the mark since they left out the most important ingredient for making a significant change in student's learning – the quality of teaching (Stigler & Hiebert, 1999).

Perry (2000) argues that in order to achieve successful mathematical understanding, teaching must go beyond telling children how to solve problems, and get them to a point where they are not only successfully producing mathematical solutions but also understanding why and when procedures are applicable and work. However, Cooney et al. (1998, as cited in Cooney, 1999) found that teachers consistently equate good teaching with good telling through a step-by-step instruction in order to avoid confusing the students. While the counterpoint to telling should not be to never tell, it is the context that should determine when telling is appropriate and when it can interfere

with students' mathematical development (Cooney, 1999). Thus, a crucial feature that must change in today's instruction has to do with the stipulation that teachers would not "chew" and feed their students with the knowledge they want to impart on them. The knowledge must be built in class by the student with the guidance of the teacher if it is to turn into long term knowledge and guide the students in future problem solving.

Therefore, the purpose of my study is to explore a potential tool for teachers, namely, the lesson study, that would help them develop and improve lessons which build upon and make use of students' thinking and previous knowledge as well as allow them to share ideas and information among the teachers community and draw on each other's experience and learnt inferences. A lesson study is an actual classroom lesson taught to the students by their teacher but it embodies special features (Lewis & Tsuchida, 1998) and it is carefully and systematically studied in order to explore how to achieve a chosen goal (Fernandez, Cannon, & Chokshi, 2003, p. 172). The premise behind the lesson study is to improve teaching by identifying the changes needed to facilitate student learning. Student learning and achievement is always at the center of the lesson study focus and all efforts to improve lessons are evaluated according to clearly specified learning goals (Stigler & Hiebert, 1999).

Teaching Experience and the Challenges that Novice Teachers Face

According to Wong (2004), the ultimate purpose of any school is the success and achievement of its students, which depend mostly on the teachers and what they know and are able to do in the classroom. Variations in students' achievements can be more

than 90% accounted for by differences in teacher quality (Wong, 2003) whereas "the most effective teachers produce as much as six times the learning gains as the least effective teachers" (Wong, 2003, p. 1). Thus, improved teacher performance can lead to improvement in students' achievements (Wong, 2003).

Moir and Gless (2001) stress the importance of the first few years for teachers as they form professional norms, attitudes, and standards, which will guide their practice over the course of their career. Results from studies examining teaching experience as an indicator of student outcomes are mixed. While some researchers did not find a statistically significant correlation between teaching experience and student achievements (Nye, Hedges, & Konstantopoulos, 2000), increased student achievement is undoubtedly tied to long-term teacher retention (Wong, 2004). Darling-Hammond (1995) presented studies showing that experienced teachers are more effective than beginners at resolving problems arising in both class instruction and class management. Among other things, expert teachers are more sensitive to students' needs and individual differences; they are better at encouraging and motivating their students; and they can draw from a wider repertoire when addressing students' needs. Furthermore, Meyer (2004) concluded that expert teachers, when compared to preservice and first-year teachers, make use of their prior knowledge during instruction in a way that allows them to focus on their students, and enhance their ability to work in a more flexible way, shifting between science and life experience.

Learning to teach is very complex and it is different for new and experienced teachers. Beginner teachers usually focus on content that the students need to know, and

are organized around what they need to get through the teaching day. Since these teachers have limited focus and poorly organized knowledge, it is very hard for them to interpret correctly the events in their classroom. In contrast, expert teachers, who are more familiar with the content and teaching, are able to focus on their students, include wider ranges of meanings into the lesson, and be more flexible with students' ideas (Meyer, 2004). Thus, Moir and Gless (2001) conclude that a knowledgeable and skillful veteran, more than anything else, has the power to move a novice teacher to higher levels of teaching, especially through problem-solving issues of practice, and an on-going "joint work" in the context of the teacher's classroom.

In addition to the difficulties they face with implementing the instruction, a common complaint among new teachers in the U.S. is the isolation they experience in the schools (Wong, 2004; Stigler, Fernandez, & Yoshida, 1996). Although most national curriculum standards call for teachers to create active and stimulating learning environments that encourage higher-levels of student thinking, appropriate setting are not provided, without which, new teachers will either teach in the same way they were taught, or leave the profession all together (Freiberg, 2002). Smith and Ingersoll (2004) estimate that 3 out of 10 teachers move to a different school or leave teaching all together at the end of their first year in the profession.

Currently, because of the shortage of teachers, unqualified teachers are being hired and assigned to the most difficult settings, causing attrition of teachers and abandonment of the profession (Darling-Hammond, 1995). As many as 35% of new teachers hired by the city if Houston in 2000 did not have a B.A. degree (Cross &

Rigden, 2002). This leads to instability in the schools, where students are being taught by batteries of substitute teachers who are inexperienced and lack the support they need, ultimately leading to school failure and perpetuate the attrition cycle (Darling-Hammond, 1995).

Major changes, both in content and governance of teacher licensing must improve since the current standards requirements of teacher knowledge and competence are inadequate. Shortage of teacher must be met by enhancing incentives rather than creating emergency, temporary, and alternative routes to teacher certification (Darling-Hammond, 1995). In addition to recruitment of new teachers and improvement of teachers' preparation, Darling-Hammond (1995) suggests improving teacher retention and effectiveness through support programs, including coaching and mentoring, during the beginning of the teaching stage, when 30-50% of new teachers leave the profession.

In order to make teaching mathematics effective, Lappan and Theule-Lubienski (1994) assert that teachers require three kinds of knowledge: knowledge of mathematics, knowledge of students, and knowledge of the pedagogy of mathematics. These are the mediators of how they will eventually teach mathematics (Even & Tirosh, 1995) which is often lacking for preservice teachers who, for the most part, have last studied mathematics as teenagers in high school (Cooney, 1999). Cooney (1999) points to preservice teachers' deficit of solid grounding in school mathematics and in the way mathematics can be applied to real-world situation, and calls for teacher education to address these connections within the mathematics these teachers will eventually have to teach.

Wong (2004) asserts that in order to produce effective teachers, preservice training is far from enough, and professional development programs that aim to improve teachers' skills must be available and grounded at every point in their career. Smith and Ingersoll's (2004) examined the effects of induction activities, such as mentoring, collaboration with other teachers, or other additional resources, on first-year teachers' decision to continue at their job for a second year. They analyzed data drawn from a cohort that included all teachers in the U.S. in 1999-2000 and compared the retention of those who did and did not participate in various induction activities. They found a strong link between induction programs and reduced rates of teachers' turnover. Furthermore, they concluded that some of the most salient factors for reducing teachers' turnover are having common planning time with other teachers in the same subject or collaboration with other teachers on instruction. However, currently in the U.S., there are no national learning and curricular goals, and in many cases, not even a set of district-shared learning goals, which are the minimum requirement for teachers to collaborate effectively (Stigler & Hiebert, 1999).

Winstead-Fry (2007) analyzed the experiences of four first-year teachers which she chronicled through monthly interviews. She divided the support the teachers received into three categories: basic induction – mentoring and supportive communication from an administrator; level II induction – seminars or common planning time with other teachers; and level III induction – participating in an external teaching network, reduced number of preparations, or an aide. She reported that in the literature, each level, when combined with a higher level, is more effective for teacher retention. Her findings show

that well-designed induction programs that take into account the support novice teachers require in order to survive the classroom management, curriculum, and instructional challenges, and the feelings of isolation, can contribute to a higher retention rates among teachers (Winstead-Fry, 2007).

Induction Programs that Create Collaboration between Novices and Experienced Teachers

In recent years, growing support have led to more guidance and orientation programs – referred to as induction – for beginning elementary and secondary teachers, transitioning them into their first job as teachers (Smith & Ingersoll, 2004). According to Wong (2004), "induction is a systemwide, coherent, comprehensive training and support process that continues for 2 or 3 years and then seamlessly becomes part of the lifelong professional development program of the district to keep new teachers teaching and improving toward increasing their effectiveness" (p. 42).

Since it can help beginning teachers systematically expand their repertoire of teaching strategies instead of relying on trial and error (Freiberg, 2002), school districts and outreach programs have endeavored to provide support during the induction period – the time period and the actual support provided to novice teachers – the first three years of teaching (Winstead-Fry, 2009). The TEAMS (Teacher Education for the Advancement of a Multicultural society) program, for example, is a collaborative model that creates partnerships to provide support and assistance for new teachers based on the assumption that the result will be an emergence of capable teachers, committed to a career in public

school teaching (Nunez & Fernandez, 2006). Wong (2004) showed the low attrition rates for schools that used a comprehensive, coherent, and sustained induction programs as well, which he claimed are the essential components of effective professional development. In fact, in Tucson, Arizona, for the Flowing Wells School, the induction program had no clear-cut timelines. After the initial induction years for new teachers, their training and support simply melded into an ongoing career-long professional development. The induction was just the first phase followed by lifelong in-house courses, which are designed for veteran teachers' renewal and growth, and turned the school into one of the most effective school district in the United States (Breaux & Wong, 2003).

Turley, Powers, and Nakai (2006) tracked novice teachers who participated in the Beginning Teacher Support and Assessment induction through their first five years of teaching and investigated into their concerns, levels of confidence, professional growth, job satisfaction, and retention. They found that induction support adds value to new teachers' classroom practice and contributes to their increased confidence and skill. It also may enhance self-efficacy - "the conviction that one can successfully execute the behavior required to produce outcomes" (Bandura, 1977, p. 193) for beginning teachers (Winstead-Fry, 2009), which studies have showed relates to their behavior in the classroom (Tschannen-Moran & Hoy, 2001). Tschannen-Moran and Hoy (2001) concluded that teacher efficacy influences teachers' instructional strategies, student engagement, and classroom management. It affects the effort they put into teaching, the goals they set, their level of aspiration, and their resilience and persistence in the face of

setbacks. Thus, as Moir and Gless (2001) state, mentoring from skilled veteran teachers who possess strong interpersonal skills, respect for multiple perspectives, and outstanding classroom practice, among other thing, can promote not only teacher retention, but the highest quality of instruction possible.

However, the mere presence of an induction program is not enough to ensure their quality which provides assistance and feedback, and actually improve beginner teachers' practice (Winstead-Fry, 2007), since such programs vary in their substance and quality (Kelley, 2004). Although during the 1999-2000 school year, almost 80% of beginner teachers in the United States received some form of induction support, attrition and turnover rates remain high (Smith & Ingersoll, 2004). Programs need to be implemented meaningfully and to effectively respond to novices' needs in order to achieve the high retention levels of beginner teachers – above 90% - that successful programs report (Kelley, 2004). Winstead-Fry (2009) conducted interviews, observations, e-mails exchange, and collected photographs from four beginning teachers, investigating into what makes novice teachers feel successful and want to remain in the profession. She concludes that teacher education and K-12 personnel who are responsible for the induction need to consistently and effectively provide research-based support rather than leaving novices to find it on their own, and underscores the importance of effective student teaching placements with cooperating teachers who mentor in addition to just providing a place to hone teaching skills. Furthermore, Winstead-Fry (2007) claims that research must not only quantitatively examine the presence of induction programs, but qualitatively assess them as well. To that, Moir and Gless (2001) add that "the goal of

these programs must be to not only retain teachers, but also to promote ambitious levels of classroom instruction that will help all students be successful" (p. 110).

The Japanese Model and the Japanese Lesson Study

Results from the video study, conducted as part of the Trends in International Mathematics and Science Study (TIMSS) assessment, clearly showed that Japanese students consistently scored above international average (Mullis et al., 2004; Martin et al, 2004) and rekindled American mathematics educators' interest in Japanese mathematics instruction (Watanabe, 2001). Considerable interest has been directed towards the mathematics achievement of students in Japan, focusing on the instructional strategies of teaching and learning used by Japanese teachers (House & Telese, 2008), as the study indicated a substantial difference in content, coverage, and focus between the Japanese and U.S. mathematics education practices (US Dept. of Education, 1996, 1999).

This difference between the two cultures was termed "the teaching gap" by Stigler and Hiebert (1999, p. 10) and refered to the commonly used teaching methods that students experience in their day-to day schooling life within each culture. Kroll and Yabe (1987) assert that although schooling in both the U.S. and Japan are organized in a similar way, Japanese schooling is more demanding time-wise, subjects are studied in more depth, and students receive a broader range of instruction. In particular, mathematics instruction in Japan are focused on developing students' thinking and problem solving strategies by organizing an entire lesson around student-led exploration of multiple solutions to a single problem (Stigler et al., 1996); by presenting open-ended

questions that allow students to develop multiple strategies for solving the same problem (Becker et al., 1990); by using concrete representations that encourage flexible thinking, allow the discovery of manipulative strategies, and the mastery of multiplicity of mental representations of mathematical ideas (Kroll & Yabe, 1987); and by providing more extended, complex, and better quality explanations to the students (Perry, 2000); proving that in recent years, Japanese elementary school teachers have succeeded in changing their approach to science teaching, reforming it from "teaching as telling" to "teaching for understanding" (Lewis & Tsuchida, 1998, p. 12). Furthermore, Japan has succeeded in developing a system that does not only develop teachers but also develops relevant knowledge about classroom teaching that is sharable throughout the teaching profession. In fact, Japanese lessons emphasize the kind of discourse described in U.S. reform documents to a greater extent than U.S. lessons do (Stigler & Hiebert, 1999).

In contrast, American students' goal is to learn the procedure for getting the correct answer to a problem, and not to understand why the procedure is mathematically valid, believing that a math problem has a single correct answer; that, if the problem is solvable, the answer can be determined within 10 minutes; and that the teacher is the final authority of the correct answer (Stigler et al., 1996). Consequently, the TIMSS assessment confirmed that efforts to reform the education system in the US often influenced classroom teaching at the margins, if at all (Hiebert & Stigler, 2000).

Using a different angel, Watanabe (2001) has also tried to find differences in Japanese and American instruction but focused on the mathematics textbooks as they are the main source for teacher. However, relying on textbooks did not mean the students'

textbooks, but rather the teacher's manuals accompanying those books. A careful study of teacher's manuals both in japan and the US has revealed major differences between the two, underlying features that existed in the Japanese manuals but were non-existent in the American ones and vise-versa.

The uniqueness of the Japanese organizations of the manuals was in the fact that the professional development section was closely connected to daily lessons, while the US series contained a separate booklet on professional development, which dealt with much broader issues. Other ideas that may help teachers in teaching their everyday lessons were integrated throughout the Japanese teacher's edition and in the descriptions of lessons. Thus, boxes of suggestions on how to meet individual student's needs, what to do with students who completed the tasks early, or how to connect the lesson to other subject matter, were available in the beginning of each lesson and created an overwhelming amount of information in the Japanese teacher's edition. In addition, the Japanese manuals contained a second set of instruction plans for the majority of the lessons, while the US manuals did not. Moreover, the Japanese manuals contained a section discussing how to prepare these instruction plans (Watanabe, 2001).

One of the most effective features presenting the big picture in the Japanese manuals was a section of flowcharts showing the development of contents across the elementary curriculum. While in the US manuals, a typical scope and sequence chart was included, the flowcharts in the Japanese manuals had much more clearly presented how specific mathematical ideas are developed. In addition, in the beginning of each unit, was an abbreviated flowchart that showed the development of particular mathematics topics

for the current year, the previous year and the following year. That way, suggestions about what not to discuss were also added since those ideas were to be developed in the following year (Watanabe, 2001).

Many more differences were found between the manuals of the two countries, including a dictionary of mathematics education vocabulary including technical mathematics education terms and phrases in the Japanese manuals which were non-existent in the American manuals US manuals; relevant children's literature, including stories, poems, and songs, to support mathematical ideas in the unit to set a theme for each unit in the American manuals which were absent from the Japanese manuals; worksheets that played a key role in the American lessons, as opposed to the Japanese lessons which seemed to expect students, as young as first graders, to use their own notebooks; and more (Watanabe, 2001).

Although, in general, the teacher's manuals for the Japanese manuals were much more prescriptive than those of the US, they gave teachers much more freedom to choose activities, pacing, etc. Furthermore, even though the Japanese manuals were prescriptive, they encouraged teachers to study the material more carefully and polish their daily lessons, given that the second volume of the Japanese manual was designed to provide a resource for 'lessons study', a common form of professional development activity in Japan (Watanabe, 2001).

Darling-Hammond (1995) stresses that in order to facilitate true reform; teachers must be better prepared and provided with a solid understanding of how children learn and develop, and how organizational changes to the schools and classrooms could

support their growth and achievement. Above all, teachers must assume greater responsibility at all levels of educational decisions, "including a more active, integrated, and intellectually challenging curriculum, and a broader range of roles for teachers in developing curriculum and assessment of student performance; coaching and mentoring other teachers; and working more closely with families and community agencies" (Darling-Hammond, 1995, p. 478).

A central characteristic of mathematics teaching in Japan is the frequent exposure of students to alternative solution methods for solving a problem, which are usually presented by several different students in the class (Shimizu, 1999). This open-ended approach focuses on mathematical inquiry and uses incomplete problems with multiple correct answers or approaches to solve the problem, offering the students the experience of learning something new in the process, using their prior knowledge, skills, and ways of thinking (Becker & Shimada, 1997). This emphasis on the development of flexibility in mathematical thinking through the mastery of multiplicity of mental representations of mathematical ideas (Kroll & Yabe, 1987) forces teachers to anticipate students' responses to the posed problem, and to consider, both in planning and during the lesson, the diversity of experience and knowledge of the different students in the class (Shimizu, 1999). Teachers having to come up with those anticipated responses, however, are greatly supported in Japan by many sources, reference books, and publications (Stigler et al., 1996).

Stigler et al. (1996) point to the degree to which student thinking is stressed in Japanese and American mathematics classrooms as most prominent. Though American

teachers may take into account students' prior knowledge, for the most part, in contrast to the Japanese teachers, their lesson plans do not reflect it. Such coherence allows students to infer connections between topics within the curriculum, insuring that the most important links can be made by the students themselves. In addition, Japanese students are given more opportunities to think during instruction and are less rushed than American students (Stigler et al., 1996), who receive almost all new instruction in the form of explanations (Perry, 2000). Finally, in Japanese education there is a great deal of effort put into the message that mathematics authority lies in the methods themselves and not in the teacher, and thus mimicking the mathematics profession rather than memorizing mathematical procedures (Stigler et al., 1996).

Japanese teachers repeatedly pointed to the impact of lesson study as central to individual, school-wide, and even national improvement of teaching (Lewis & Tsuchida, 1998). A lesson study is a comprehensive and well-articulated process for examining practice that many Japanese teachers engage in. It may provide some answers to questions such as what is the best way for teachers to look at, talk about, and learn from their daily work?, what questions should teachers ask themselves about their practice, and what tasks should they work on to structure this examination? (Fernandez et al., 2003). The lesson study is so relevant to the improvement of classroom teaching because of its focus on the lesson itself as the unit to be analyzed and improved (Stigler & Hiebert, 1999).

The lesson study process begins with teachers identifying a lesson study goal (e.g. helping students become autonomous and critical thinkers) and content area (e.g. science

or language arts) that they want to work on together. They then spend the bulk of lesson study time collaboratively discussing a small number of lessons they have first jointly planned and carefully observed. Work on these study lessons begins with teachers first jointly drafting a detailed lesson plan so that one of them can eventually teach the lesson to his/her students while others observe. The teachers then meet to discuss their observations and ideas for how to improve the lesson, and these discussions are either followed by the group choosing to work on a new lesson or, as is often the case, by the group revising the lesson plan, re-teaching the lesson in a different classroom, and again meeting to discuss the second lesson implementations (Fernandez et al., 2003). The teachers exchange ideas about the lesson with a focus on the content taught and on the teacher's roles assumed during the lesson, and experienced teachers and mathematics educators are sometimes invited to comment on the observed lesson, on the interpretations of the topic taught, and on how the lesson can be further improved (Shimizu, 1999). It is a system of collaborative learning from actual instruction with the use of investigation, planning, research lesson, and reflection, aiming to create a change in teachers' knowledge and beliefs, professional community, and teaching-learning resources (Lewis, Perry, & Hurd, 2009).

Preservice Japanese teachers are intensively taught how to write and polish lesson plans and how to communicate through them about a topic to be taught, expected students' responses to problems presented, and the important teacher roles. They are also taught how to analyze a lesson in accordance with its objectives, and in relations to both the current and previous topic, and within the topic. These interpretations are a crucial

part of planning the lesson and will greatly determine the success of the lesson (Shimizu, 1999).

As it is practiced in Japan, the lesson study process offers opportunities for teachers to learn through collaboration with colleagues as well as time for study and reflection. Designing and testing a lesson study provides a rich context in which the teachers can improve their own knowledge and skills and thus the teacher improvement paradigm as it currently exists in the U.S. is reversed – working on improving teaching yields teacher development and not the other way around (Hiebert & Stigler, 2000).

Perry (2000) points to the mathematical explanations provided in the classroom as a key component of the differences between the U.S. and Japan. She found that the explanations provided in Japanese classes are more generalizable across problems in comparison to the U.S. and thus, are more powerful. She also points to the fact that although both U.S. and Japanese students hear explanations of how to solve problems, they do not all hear explanations about mathematical principles and function, assuming that if a student can know why a procedure works and when to use it, he or she will be better equipped to handle novel problems and use this learned procedures versus a student who does not.

However, at least part of the reason that explanations fall short in the U.S. classrooms in comparison to the Japanese ones rests on teachers' understanding of the mathematical concepts that are taught. Teachers who are better at the mathematics that they teach should be able to better explain these concepts to their students than teachers who do not have a deep and connected understanding of mathematics (Perry, 2000). New

teachers have different levels of knowledge, skills, and understanding of content and pedagogy and the type of mentoring they receive should address their personal needs and contribute to their personal growth (Turley et al., 2006). Many teachers do not have sufficient subject-area knowledge, nor do they possess good instructional skills in order to teach students from a diverse background and match their achievements with the academic state's standards (Cross & Rigden, 2002). In fact, some education programs do not consider content-knowledge as their responsibility, nor do they require future high school teacher to major in the academic subject they are going to teach, as is the case in thirty states in the U.S. (Cross & Rigden, 2002).

It seems that the lesson study holds the potential to address both students' achievement and teacher retention and success. As the novice teachers receive the support and resources they need in their first years of teaching, a light is shed on students' knowledge and achievement in a supportive environment that allows the teachers to consult, be advised, and make mistakes without being judged.

Cultural Differences between American and Japanese Teachers and their Effect on their Beliefs and Attitudes towards Teaching

Stigler and Hiebert (1999) define teaching as a cultural activity possessing cultural scripts that are "learned implicitly, through observations and participation and not by deliberate study" (p. 86). In fact, the way teaching is conducted within a culture is so widely shared that it is invisible, at least in part, even to those who teach (Hiebert & Stigler, 2000), and this perhaps explains why teaching has been so resistant to change

(Stigler & Hiebert, 1999). Teachers learn how to teach indirectly, from being students themselves, and are mostly unaware of the most widespread attributes of teaching in their culture. In fact, although there are variations between teachers within the U.S., these differences pale when compared across countries from a cross-cultural, comparative perspective, and illuminate a distinct American way of teaching, which differs immensely from the Japanese way (Stigler & Hiebert, 1999).

Smith (2005) claims that teachers enter the profession with strong beliefs that emanate from their total lived-experience which influence their idea of what science is and how it should be taught. According to Cooney (1999), preservice teachers view their own teachings of mathematics as similar to the way they experienced it as students, most often, consistent with the mode of teaching as telling. In addition, teachers bring beliefs and expectations to the classroom and these beliefs differ greatly between the Japanese and the Americans, and result in very different instruction (Stigler et al., 1996).

In the United States, once completing their education or training program, teachers are perceived as competent (Stigler & Hiebert, 1999). In contrast, new teachers' training in Japan is not thought to begin until they start their first teaching job, where they begin a long apprenticeship-like training, closely supervised by veteran teachers (Stigler et al., 1996). They are required to participate in a year-long induction program since they are considered to be novices who need the support of their experienced colleagues (Shimizu, 1999). They are also expected to participate in professional-development programs as part of their job (Stigler & Hiebert, 1999). For each new teacher, an experienced teacher is assigned to help the novice make a successful start of their

educational career and to learn and practice the different roles expected during the lesson through approximately 300 hours of closely supervised and monitored teaching, with some of the lessons being observed. In addition, novice teachers are required to attend at least 20-30 full or partial days of further training at educational centers, and have many opportunities to participate in lesson-study workshops which are regularly held for both novice and experienced teachers (Shimizu, 1999). In the U.S., on the other hand, once a teacher finishes his or hers student teaching and receive their university degree, they are given their own classroom over which they have complete control (Stigler et al., 1996). It seems that, in Japan, teaching is viewed as a craft or a skill that can be perfected in a more structured and delimited process, benefiting from shared tricks of the trades with other, more experienced, teachers (Stigler et al., 1996), whereas in the U.S., the cultural belief is that "good teachers are 'naturals'. They are born, not made" (Hiebert & Stigler, 2000, p. 14). Ultimately, American teachers who are on their own for the most part, end up working hard only to reinvent the wheel and still experience more uncertainty, while Japanese teachers can focus on improving their lessons in a structured, less stressful process (Stigler et al., 1996). According to Tschannen-Moran and Hoy (2001), if the significant effect of teachers' efficacy beliefs were taken more seriously, we might have seen a considerable change in teacher preparation and support, especially in their first years in the profession. More specifically, a model that, in contrast to the sink-or-swim practice that is used today, would resembles more of an apprenticeship.

Teaching in the U.S. is considered to be a highly idiosyncratic profession, in which the teachers need to find their own way. An innovative teacher in the U.S. is one

who is independent when organizing curriculum, material, and executing his or her own original lesson, as opposed to Japan, where an innovative teacher is one who can skillfully teaches the lesson prescribed by the text (Stigler et al., 1996). As oppose to the U.S. where supposedly teachers have all the authority, in Japan, this authority lies in the curriculum and routines of teaching, which relieves some of the anxieties that American teachers face (Stigler et al., 1996).

The need for a stable and successive research-and-development system for teachers' improvement is clear but no such system currently exists in the U.S. (Stigler & Hiebert, 1999). Since preservice teachers and elementary and secondary teachers often have poor understanding of school mathematics (Cooney, 1999), this current situation leaves U.S. teachers trapped in a system that prevents them from admitting weakness in mathematical knowledge and improving upon their teaching knowledge (Stafford-Plummer & Peterson, 2009). Acknowledging that preservice mathematics teachers will not know all of the mathematics they need to teach secondary mathematics may allow them to be more teachable before they begin teaching and become lifelong learners after they start (Stafford-Plummer & Peterson, 2009). Furthermore, it thus becomes possible for teachers to be critical toward one another without offending and undermining their colleagues (Stigler & Hiebert, 1999). Investing in a teacher quality starts at the earliest stage of a teacher's career and continues throughout his professional career (Moir & Gless, 2001).

Implementing Lesson Study in the U.S.

In recent years the lesson study practice is gaining popularity and being used by American teachers all over the U.S. (Chokshi & Fernandez, 2004; Lesson Study Research Group, 2004). Lewis, Perry, & Hurd, (2009) developed a theoretical model of lesson study in order to examine the features and impact of the practice in North America, addressing issues such as the features of the lesson study; mechanics by which the lesson study is posited to improve instruction; and the evidence of effective use of the lesson study outside of Japan.

Because the lesson study as it is practiced in the U.S. is a locally-designed process, different groups may emphasize and invest considerable time in different parts of the process according to their specific needs, creating several variations of the practice. Still, the major features of the lesson study should come into play in each lesson study group, no matter the variation adapted (Lewis et al., 2009).

Lewis et al. (2009) examined a lesson study that was conducted in the U.S. and aimed for improving instruction in North America. They found evidence of changes in teachers' content knowledge, pedagogical knowledge, and teaching-learning resources; and of a growing professional community, despite the short period of the lesson study. They also found indication that the lesson study provided opportunities for making ideas more visible, which brought the teachers to rethink and revise their initial thinking about teaching-learning mathematics, and thus, proving the effectiveness of the lesson study outside of Japan.

Despite these positive results, Chokshi and Fernandez (2004) have identified challenges and misconceptions that might rise at each developmental stage of the lesson study implementation: the launching stage; understanding the work; and deepening and sustaining the work; and concluded that specific recommendations depend on different groups' specific needs and goals. First, they advised not to dwell on the practice of lesson study, but rather engage in the process since no one can really anticipate the issues and the solutions that it will produce, alongside reflection of the progress of the group. Second, they stress the importance of creating networks between different lesson study groups in order to avoid isolation and limited insight. In order to create a shared professional knowledge base in the U.S., it is crucial to share strategies and resources, as they continue to evolve in their depth and breadth of their experiences. Similarly, Stigler and Hiebert (1999) claim that the U.S. lacks a system for developing professional knowledge, sharing knowledge about teaching, and giving teachers the opportunities to learn about teaching. As it is now, American teachers have no means of contributing to a gradual improvement of teaching methods or their own skills and are left alone under the justification of freedom and independence (Stigler & Hiebert, 1999). Finally, similarly to Lewis et al. (2009), Chokshi and Fernandez (2004) highlight the need for an outside experts and advisors, as a source of information, guidance, and feedback that are critical to the lesson study process, while still remaining a teacher-directed process.

Fernandez et al. (2003) investigated into a unique collaboration between Japanese and American teachers implementing the lesson study practice in an American school whereas the Japanese teachers served as guides and advisors as they taught the lesson

study process to the American teachers and worked on one cycle with them. They highlighted the three lenses through which teachers need to look during the lesson study process: the researcher lens – the teacher as a researcher conducting an experiment with a testable and meaningful hypothesis, examining questions and collecting evidence regarding classroom instruction; the curricular developer lens – the importance of thinking about students' entire learning experience and the sequencing and connecting of children's learning experience; and the student lens – reexamine all aspects of the lesson through the eyes of the students, understanding their thinking, anticipating their behaviors, and using that knowledge to build their understanding in class. However, it seems that the American teachers had a lot of trouble adopting and maintaining the three lenses in the way that the Japanese teachers did, and they even resorted to old behaviors during the lesson observations. Their discussions lacked key components of the lesson study and relied more on intuition and less on evidence (Fernandez et al., 2003).

An explanation for such results can be found in Perry and Lewis's (2009) account of participating teachers in their seventh year of practicing in the lesson study, who still experienced "a-ha" moments regarding the application and support of the lesson study and were still coming up with ideas about making the process work better through adaptation and changes.

Fernandez et al. (2003) assert that simply having teachers engage in lesson study does not guarantee success, but rather in order for teachers to adopt the researcher's lens, they must learn to generate powerful questions, skillfully design lesson that can answer those questions, and come up with concrete evidence during the lesson, which requires a

shift in their disposition. They also emphasize that all efforts to implement lesson study in the U.S. must first and foremost focus on providing teachers with the support and guidance they'll need in order to succeed in improving their instruction through the lesson study process.

Since there are few teachers who have experienced this kind of professional development, not many exist in the field that can lead such a process (Stigler & Hiebert, 1999). Thus, in order for the lesson study to be successful in the U.S., lesson study groups may need guidance from a sufficient mathematical expert whose job is to ensure that the group seizes opportunities that arise in an effective way (Lewis et al., 2009), and bring critical perspectives about teaching and learning, and shift or redirect the focus as discussions progress (Fernandez et al., 2003), since new practitioners may have an incomplete understanding of the practice, or focus on superficial procedural aspects (Chokshi & Fernandez, 2004). In addition, school principals must take the lead, work closely with the teachers, and maintain a long-term commitment to the process, even cooperate with other principals in the district in order to rethink current practices and find creative ways to institutionalize the structures and support necessary for this process, all the while anticipating gradual and continual improvements (Stigler & Hiebert, 1999).

Perry and Lewis (2009) also emphasize the importance of sustained commitment since this is a process in which the simpler components are woven in first into the teachers' existing practice, and only later on they are able to grasp other more complicated ideas of the lesson study. According to Stigler and Hiebert (1999), part of the problem of bringing true reform to the U.S. is that American educators sought major

changes over a relatively short period of time whereas reform indicates gradual and incremental improvements over time. The system that was implemented in Japan included clear learning goals for students, a shared curriculum, administrative support, and teachers working hard in order to achieve gradual improvement in their practice (Stigler & Hiebert, 1999).

In order for the lesson study to be successful across the U.S., it must grow into and flourish from the current educational landscape. For that to happen, it must meet the needs of teachers – motivate and engage teachers and have them willingly continue the practice, and it must fit within the current political and policy contexts of American education (Stigler & Hiebert, 1999). Teachers are under so much pressure and must keep up with the increasing stakes and the lesson study has the potential to connect local standards and assessment. Because the improvements to the instructions are based in the local curriculum, the lesson study allows teacher to devote time to improvements that align with the standards for which they are held accountable. Furthermore, if the lesson study is practiced district-wide, teachers can compare and contrast results with colleagues from their district, try the lessons on different students and contexts, and ultimately result in a slow but powerful process that insures better quality and a gradual and consistent improvement of teaching (Stigler & Hiebert, 1999).

Lesson Study as a Possible Tool for New Teacher Induction Program

According to Wong (2004), "induction is a process – a comprehensive, coherent, and sustained professional development process - that is organized by a school district to

train, support, and retain new teachers and seamlessly progress them into a lifelong learning program" (p. 42). He claims that while mentoring is an important part of induction, in and of itself, mentoring is not enough unless it is a part of an established program that takes into account the district's missions and goals. However, many mentors in school districts are not a part of an induction program, but rather are simply veteran teachers assigned by the principals to new teachers as mentors. The best induction programs provide connection through their structure within learning-communities where new and veteran teachers interact and their respective contributions are valued. Thus, collegial interchange, rather than isolation, must become the norm for teachers (Wong, 2004). In the same way, Turley et al. (2006) state that effective induction programs set away time for teachers to jointly engage in staff development, observe other teachers' instruction, assess and discuss students' work, and address important questions and issues in a timely manner. Because of its complex nature, teaching is best developed and its improvement will be most successful when done in the classroom where it is actually takes place (Stigler & Hiebert, 1999).

Freiberg (2002) highlights the difficulty of new teachers to manage organizational strategies, especially since these strategies are hidden from most classroom observation, even when observing a veteran teacher. What is seen is a smoothly functioning lesson but the preparation that set the tone for a positive lesson environment was done solely by the veteran teacher. Such acquisition of organization strategies necessary for the conditions for learning should occur in a systematic way rather than depending on trial and error (Freiberg, 2002), something that can be accomplished by novice and veteran teachers

cooperating in the planning stage, an advantage the lesson study provides. Such cooperation in planning can allow novices to see the bigger picture, learn to plan backwards, and make decisions based on learner, content, and context (Freiberg, 2002). Effective induction, as it is described by Moir and Gless (2001), is one that makes new teachers become on-the-job- learners, and who are constantly and systematically questioning and inquiring into their classroom practice with their student learning in mind.

Another benefit that the lesson study can provide is what Freiberg (2002) calls "in-flight planning" (p. 57) – the ability to make changes to the lesson during the lesson. By anticipating students' responses, the lesson study provides teachers with the opportunity to plan for multiple scenarios.

Finally, it also allows time for reflection on the lesson and its modification (Freiberg, 2002). Fernandez et al. (2003) note the strong alignment between the current aspirations for American teachers and the lesson study, including the call for teachers to become more reflective in their practice, create well-connected learning-trajectories, and move towards student-centered instruction that takes into account student thinking and engagement in mathematics. According to Freiberg (2002) and Cooney (1999), this reflection is crucial for new teachers in order to build an instructional repertoire for future lessons and for the professional development of teachers. All of these features are embedded in the lesson study practice in combination with the assistance and support of veteran teachers. In addition, instructional change requires accurate ongoing feedback by an outsider, since assessing oneself is very inexact, but it is rarely done (Freiberg, 2002).

The lesson study provides several extra pairs of eyes to give accurate feedback in a non-judging environment.

When new teachers are exposed to the framework of the essential teaching skills, they can build rich pedagogical repertoires, that does not fall short than a veteran's, in less time, and this could be the factor that help more teachers succeed and remain in the profession (Freiberg, 2002). In fact, the lesson study practice possesses all of Wong's (2004) concluded components for a successful induction program, among which are learning community networks that grant both novice and veteran teachers with new knowledge; treatment of each colleague as a potential valuable contributor; and quality teaching which is the group's responsibility rather than the individual teacher. Smith and Ingersoll (2004) report the same conclusions.

Lewis, Perry, and Hurd's (2009) theoretical model posits that the lesson study makes the teachers' types of knowledge more visible, such as colleagues' ideas about pedagogy and students' thinking, and allows them to encounter different ideas than their own and refine their own knowledge. It also posits that the lesson study enable teachers' to create a professional community in which they can build the tools for instructional improvement. They point to the development of teachers' mathematical knowledge, pedagogical knowledge, inquiry stance, and professional community, as the predominant part of the gains that the lesson study embodies, whereas the revised lesson plan is a more modest gain of this process (Lewis et al., 2009).

In order for students to succeed, teachers must know how to adapt lessons in such a way that different students with different abilities and skills can still master the material

and meet high expectations (Cross & Rigden, 2002). They reported a study of seven urban districts where "the only reform effort that clearly resulted in student achievement gains had clear instructional expectations, supported by extensive professional development, over a period of several years" (Cross & Rigden, 2002, p. 27).

In line with the lesson study practice are also Winstead-Fry's (2007) concluded suggestions for effective induction programs, such as common planning time with teachers at the same grade level and content area; the development of mentoring relationships with other educators than an individual mentor assigned; providing opportunities for new teachers to collaborate with veteran teachers; and post-observation time for constructive feedback. Furthermore, "quality induction programs act as a catalyst for changing school cultures and improving the teaching profession. Powerful new models of teacher induction offer points of intersection where veterans and novices learn together as they reinvent the way teachers interact with one another" (Moir & Gless, 2001, p. 114). The classroom itself is the common channel through which all efforts to improve school learning must flow. Teachers are the ones who can ensure that students' learning improve and therefore should take the lead in engaging such an improvement, proving to be the solution for improving instruction (Stigler & Hiebert, 1999).

Connecting such peer support and the lesson study process, Stafford-Plummer & Peterson (2009) showed in their study how a teacher who presented various actions used to unknowingly keep from revealing any weaknesses in secondary mathematics, acknowledged that the lesson study has enriched and deepened her understanding of the particular topic that she had worked on with her group. She admitted that she was aware

of her lack of knowledge and commented that it had grown as she engaged in lesson study collaboration and that it forced her to rethink and redefined her fragmented knowledge of the subject.

It seems that novice teachers can benefit from working with expert teachers both in deepening their knowledge about their subject matter and in class managerial and instructional strategies aspects, and that the lesson study could be a productive vehicle for such a collaboration. Thus, in my study I will investigate into the lesson study as an effective induction tool for new teachers and explore how do novice vs. expert teachers approach the lesson study in mathematics, exploring the research questions: Are there any differences between experienced and novice teachers' perceptions of collegial learning effectiveness; expectations for students' achievements; their ability to use and promote students' thinking; and professional development?; and What elements of the lesson study process and what types of interactions that occur between experienced and novice teachers over the course of the lesson study cycle contributed to the learning and personal growth of the teachers?

METHODS

Study Design

The study used a mixed methods design, namely, an explanatory sequential design. A quantitative data analysis was used followed up by a qualitative data analysis leading to an interpretation.

The study used an existing database designed and executed by Perry and Lewis (2011). The following section presents the study design and measurements as described in their study submission (Perry & Lewis, 2011):

Site Recruitment and Group Membership

Using a national network forum listserv (Lesson Study Network, n/d) and personal networks of researchers and practitioners, Perry & Lewis (2011) recruited lesson study groups from across the U.S., resulting in more than 100 groups who requested an opportunity to participate in the study. A sample of 39 sites was selected according to Four criteria: (a) permission from local authorizing agencies and administrators; (b) willingness to be randomly assigned to a study condition; (c) site demographic characteristics (seeking diversity in region of the U.S., urbanicity and student socio-economic status); and (d) ability to participate within the study timeframe. The researchers randomly assigned participating groups to one of three research conditions: Condition 1 (C1), lesson study with the fractions resource kit; Condition 2 (C2), lesson

study without the fractions resource kit, on a topic of the group's choosing (other than fractions); and Condition 3 (C3), locally chosen "professional development as usual." Since I will only be looking at lesson study groups, teachers from condition 3 will not be included in the present study. A $4,000 stipend was offered to all of the groups upon documentation of expenses related to professional learning (e.g., substitutes, stipends for after-school work, course fees, etc.). Since, in previous study that the researchers conducted, there were lesson study groups that were reluctant to refrain from lesson study for a whole school year, the researchers set a timeframe of about 5 months for participation (late August 2009 to January 2010). The researchers created triads of demographically matched sites according to district and SES of students and one site from each triad was assigned by random draw to each of the three study conditions. The random assignment was performed only after groups had completed teacher and student pre-assessments. Although, delays altered the time frame for study participation in some groups, the average length of participation (calendar days from student pretest to posttest) was roughly the same across conditions: 91 days for Condition 1 groups; and 80 days for Condition 2 groups. No groups dropped out of the study, and only one teacher did not complete the study.

The researchers did not specify group membership in order to support naturally-occurring collaborative groups, but they did require that at least one group member would be a classroom teacher within grades 2-5. Educators who responded to the call for participation recruited local groups of 4-9 educators, and because some groups found it beneficial to collaborate across grades, the groups were allowed to include educators at

other grade levels or from non-classroom positions (e.g., mathematics coach). Even though the researchers suggested a time frame of about 12-14 group meetings, including at least one classroom research lesson, for completion of the study requirements, the lesson study groups organized their own meeting logistics, determining the total time, number of meetings, and meeting length, which resulted in a widely varied group participation time. The estimated participation time for Condition 1 groups ranged from 7- 42 hours, and the estimated participation time for Condition 2 groups ranged from 1.5-29 hours, not including the time for assessments. The variability in time devoted to the study for groups in conditions 1 and 2 is probably due to a range of factors, one of which the researchers could identify was that groups that decided to teach the research lesson more than once tended to have longer participation times. The 39 groups of educators included groups in 11 U.S. states and the District of Columbia and in 27 school districts, totaling 213 teachers across the three study conditions.

Data Collection Instruments

Pre- and post-assessments were administered at the beginning and end of the study period to all the participating teachers. In addition, participants in Conditions 1 and 2 were asked to videotape their lesson study meetings and research lessons, to submit related artifacts from the lesson study cycle (such as student work and lesson plans), and to complete a reflection form at the end of each meeting and end of the lesson study cycle. Data were collected through an ongoing exchange of materials between the researchers' office and each research site. Assessments and toolkit binders were mailed to each remote site with guidelines for their administration and use, and sites mailed back

research materials – such as teacher and student pre- and post-assessments, video data cards, lesson artifacts and written reflections. The resource kits were sent out only after pre-assessments had been received in the researchers' office. The researchers collected data on teachers' knowledge of fractions, students' knowledge of fractions, teachers' beliefs and dispositions related to instructional improvement, and teachers' written reflections on what they learned from the lesson study cycle. I will elaborate on the measures relevant to my study in the next section.

Measures

Perceived collegial learning effectiveness (Perry & Lewis, 2011). The purpose of this attitude scale is to measure teachers' dispositions regarding the effectiveness of collegial learning before and after engaging in lesson study. It includes 5 items on a likert-scale. An example item includes: "I have learned a lot about student thinking by working with colleagues".

Expectations for student achievement (Perry & Lewis, 2011). The purpose of this attitude scale is to measure teachers' expectations regarding their ability to effect students' achievements. It includes 7 items on a likert-scale. An example item includes: "By trying a different teaching method, I can significantly affect a student's achievement".

Teacher Reported Using and promoting student thinking (Perry & Lewis, 2011). The purpose of this attitude scale is to measure teachers' perceptions regarding their ability to understand and use their students' thinking during their lesson. It includes

4 items on a 5-point likert-scale. An example item includes: “I have some good strategies for making students’ mathematical thinking visible”.

Perceived impact of professional learning (Perry & Lewis, 2011). The purpose of this attitude scale is to measure teachers’ perceived impact of professional learning. It includes 6 items on a likert-scale. An example item includes: “I feel supported by other teachers to try out new ideas in teaching”.

End of meeting and end of cycle written reflections on what was learned (Perry & Lewis, 2011). This assessment included one open-ended question aimed to understand the change/transformation or lack thereof in teachers’ perception of the lesson study process: “Describe in some detail two or three things you learned from this lesson study cycle that you want to remember, and that you think will affect your future practice. These might be things about fractions or mathematics, about teaching, about student learning, or about working with colleagues. (If you don’t feel you learned anything from this cycle of lesson study, please note that and identify changes that might have made the lesson study work more productive for you)”.

Data Analytic Approach

The current study only looked at the lesson study groups (conditions 1 & 2) and began by using the pre- and post-assessment to identify changes in the survey measures for teachers, in order to take a closer look at the groups indicating substantial change.

The next step looked at the demographics and identified novice and expert teachers, and selected a small number of cases in which novice teachers showed substantial growth as well as teachers who have not shown change and qualitatively code

videos from those cases. Using the teachers' written reflections, an open coding system was created and an interpretation of the lesson study as an induction tool for novice teachers was proposed.

Even though the initial aim of the study was to explore novice vs. experienced teachers, the analysis showed no significant differences between novice and experienced teachers in terms of communication time, or positive vs. negative comments in the videos and/or the written reflections. Therefore, the study's focus shifted to exploring the range of experiences that the teachers' went through during the lesson study cycle, with special emphasis on the dynamics between the novices and experienced teachers, that contributed to their learning and personal growth. The research questions and the data analytic approach are described in table 1.

Table 1
Research Questions and Data Analytic Approach

Research Question	Participants	Data Collection Instrument	Analytic Approach
1. Are there any differences between experienced and novice teachers' perceptions of collegial learning effectiveness; expectations for	Mixed groups of novice and expert teachers conducting a lesson study cycle.	Phase I: Locate mixed groups of novice and expert teachers from all the groups that conducted the lesson study.	Phase I: -Perceived Collegial Learning Effectiveness -Expectations for student achievement -Using and promoting student thinking (reported) -Perceived Impact of

students' achievements; their ability to use and promote students' thinking; and professional development? 2. What elements of the lesson study process and what types of interactions that occur between experienced and novice teachers over the course of the lesson study cycle contributed to the learning and personal growth of the teachers?		Phase II: Quantitative analysis of pre- and post-tests to identify groups that showed great increase (vs. little) in the tested variables Phase III: Videotapes analysis to interpret the quantitative finding.	professional learning -End of meeting and end of cycle written reflections on what was learned Phase II: Use demographics information. Phase III: Qualitative open-coding of teachers' behavior.

VALIDITY

The main validity threat of a study is that the data would lead to invalid conclusions (Maxwell, 2005). This section will describe the methods and approaches taken to minimize such validity threats.

Selection of the Data

In choosing the participating groups, "purposeful sampling" was used – "a strategy in which particular settings, persons, or activities are selected deliberately in order to provide information that can't be gotten as well from other choices" (Maxwell, 2005, p. 88), to narrow down the 39 original groups to a two-group case study. First, the groups from condition 3 – "professional development as usual" were eliminated, and 26 groups from conditions 1 and 2 remained.

Then, by looking at the demographic information, the groups were narrowed down to mixed groups of at least one novice (less than 5 years of teaching experience) and one experienced teacher (more than 15 years of experience). However, only groups whose participants were somewhat evenly distributed in terms of teaching experience were chosen. For example, a group with four experienced teachers and one novice was disqualified. Looking into such groups can make for a very interesting follow-up study which might reveal further insight that might have not been discovered in this study. Groups of over 6 participants were also eliminated since the nature of the study required

an in-depth analysis into each individual participant as well as the whole group, and a large size group might have made the process much more difficult and hindered the coherency of each member of the group.

Being left with six groups from condition 1 and four groups from condition 2, three groups of each condition were randomly selected and their videotaped data were requested from the researchers of the original study. After further eliminating groups which had audio problems, and by looking at the groups reflections, two groups from the same condition – condition 1 – were chosen, one that expressed a lot of positive comments about the process, and one that had expressed some criticism of the process. Selecting these two groups provided for the information best suitable in order to answer my research questions; achieving representativeness or typicality of the settings, individuals or activities selected; adequately represent the entire range of variation; deliberately examine cases that are critical for the theories presented and developed; and establishing particular comparisons to illuminate the reasons for differences between settings or individuals (Maxwell, 2005).

Comparison

The comparison between two different sites is a good way to counter the objection of using causality in a qualitative study and address what might have happen without the presence of the presumed cause (Maxwell, 2005).

In the case of this study, however, the comparison between the two groups also served to examine a wider range of experiences for participants in the lesson study process and aimed to gain further insight into their different reactions to it. Even though

one group had more positive comments in their reflections than the other, negative comments or criticism does not necessarily suggest failure since sometimes difficulty and struggle might lead to more learning.

Discrepant Evidence

"Identifying and analyzing discrepant data and negative cases is a key part of the logic of validity testing in qualitative research. Instances that cannot be accounted for by a particular interpretation or explanation can point to important defects in the account" (Maxwell, 2005, p. 112). Choosing two contradicting cases of the same process, one containing positive comments, and the other, containing more critique, allowed for a fuller description of the range of experiences of the lesson study process.

Triangulation

By analyzing two sources of data – the videos and the written reflections, using two different methods – observation and self-reported survey, the risk of chance association and of systematic biases due to one specific method is reduced and allows for a better assessment of the generality of the explanations developed (Maxwell, 2005).

Quasi-Statistics

"The use of simple numerical results that can be readily derived from the data […] not only allow to test and support claims that are inherently quantitative, but also enable to assess the amount of evidence in the data that bears on a particular conclusion or threat" (Maxwell, 2005, p. 113). By mapping and color-coding the interactions and themes that emerged in the meetings, the data were converted into statistically

represented numbers, supporting the descriptive account of the investigation. However, these results should be reviewed with caution since no inter-reliability was performed for the color-coding.

Reactivity and Reflexivity

Using a secondary data source has prevented the researcher from becoming personally involved in the social world of the subjects and prevented the study from having an effect on the participants of the study. However, there is no information regarding the reflexivity and reactivity of the researchers of the original study on the participants. Hopefully, other features of the study, such as the long-term involvement, triangulation, and multiple data types helped minimize such an effect.

Intensive Long-Term Involvement

The process for the two groups in this study was conducted over the course of 3.5 months for group 1 and 5 months for group 2, during which all the meetings were videotaped and carefully reviewed and analyzed. The use of the camcorders allowed for multiple reviews of the data and offered complete representation of the meetings. The data are direct and less dependent on inference and allow for greater opportunity to develop and test alternative hypotheses (Maxwell, 2005). However, any informal conversation that took place outside of camera range or at different times during the study was not accessible or even known to the researcher and there is no way of knowing if it could support or contradict the evidence or shed any further light on the conclusions.

Rich Data

A set of data provides a rich and detailed grounding for, and test of, conclusions (Maxwell, 2005). Since the study focused on two groups as a case study, an in-depth look into the data was possible. All of the videos were watched at least once and were partially transcribed and mapped according to times and participants. The transcriptions were reviewed at least twice. These data consisted of the majority of the evidence and supported it with examples and pattern samples. The data also allowed to rule out the danger of respondent duplicity (Becker, 1970, as cited in Maxwell, 2005) as the written reflections of the participants were compared against their conduct during the lesson study process. However, since the study used a secondary data set, there was no way of doing a respondent validation, or a "member check" in which participants can provide feedback on the researcher's analysis and conclusions in order to rule out the possibility of misinterpreting the meaning of what participants say or do and the perspective they have on what is going on as well as identifying the researcher's own biases and misunderstandings of the observed (Maxwell, 2005).

Generalizability

Because of the small-size sample and the use of purposeful sampling, this study was not able to make external generalizability claims beyond the setting of the two groups. However, an internal generalizability within the two cases studied has been attempted. "The descriptive, interpretive, and theoretical validity of the conclusions of a case study all depends on their internal generalizability to the case as a whole" (Maxwell, 2005, p. 115). Still, as Maxwell (2005) explains, "this does not mean that the study is not

generalizable beyond the settings or informants studied. First, there is no reason not to believe that the results may apply more generally" (p. 116); and "second, the generalizability of qualitative studies is usually based not on explicit sampling of some defined population to which the results can be extended, but on the development of a theory that can be extended to other cases" (Becker, 1991; Ragin, 1987; Yin, 1994, as cited in Maxwell, 2005, pp. 115-116).

RESULTS

The original dataset included 39 lesson study cycles – 39 groups of teachers who worked on one lesson from beginning to end ranging between 7 and 42 hours, and included their meetings and at least one classroom research lesson.

The lesson study cycles included three different conditions – groups that used the lesson study cycle and a fractions resource kit designed by Perry and Lewis (2011); groups that used the lesson study cycle without the fractions resource kit, on a topic of the group's choosing; and groups that chose "professional development as usual". In the present study the two conditions used were conditions 1 and 2 – both implementing the lesson study, which included 26 groups from the original study.

To test the first research question - are there any differences between experienced and novice teachers' perceptions of professional learning; perceived collegial learning effectiveness; expectations for student achievement; and their ability to promoting student thinking? – an independent sample t-test was performed, using only teachers with less than 5 years of teaching experience, classified as 'novice', and teachers with more than 15 years of teaching experience, or 'experienced' (see table 2).

Table 2
Experienced and novice teachers' change in perceptions following a lesson study cycle

Groups based on experience		N	Mean	SD	t
Collegial learning effectiveness-change score	novice	60	.10	.53	.44
	experienced	54	.05	.59	.43
Expectations for student achievement-change score	novice	60	-.25	.51	-.48
	experienced	54	-.20	.58	-.48
Using/Promoting student thinking-change score	novice	60	.08	.58	.42
	experienced	54	.04	.55	.42
Perceived impact of professional development	novice	59	4.05	.77	-1.17
	experienced	52	4.21	.67	-1.18

*$p < .05$.

For the first variable – 'collegial learning effectiveness' - an independent sample t-test analysis indicated that the 60 novice teachers had a mean of .10 of the changed score from the pre- and post-test, the 54 experienced teachers had a mean of .05, and the means did not differ significantly at the $p < .05$ level (note: $p = .66$). Levene's test for equality of variance indicates variances for novice and experienced teachers do not differ significantly from each other (note: $p = .77$).

For the second variable – 'expectations for student achievement' - an independent sample t-test analysis indicated that the 60 novice teachers had a mean of -.25 of the changed score from the pre- and post-test, the 54 experienced teachers had a mean of -.20, and the means did not differ significantly at the $p < .05$ level (note: $p = .63$).

Levene's test for equality of variance indicates variances for novice and experienced teachers do not differ significantly from each other (note: $p = .71$).

For the third variable – 'using and promoting student thinking' - an independent sample t-test analysis indicated that the 60 novice teachers had a mean of .08 of the changed score from the pre- and post-test, the 54 experienced teachers had a mean of .04, and the means did not differ significantly at the $p < .05$ level (note: $p = .68$). Levene's test for equality of variance indicates variances for novice and experienced teachers do not differ significantly from each other (note: $p = .78$).

For the fourth variable – 'perceived impact of professional development' (measured at post-test only) - an independent sample t-test analysis showed that the 59 novice teachers had a mean of 4.05 at post-test, the 52 experienced teachers had a mean of 4.21, and the means did not differ significantly at the $p < .05$ level (note: $p = .25$). Levene's test for equality of variance indicates variances for novice and experienced teachers do not differ significantly from each other (note: $p = .75$).

Although not statistically significant, the means show a definite trend in which novice teachers show greater improvement in their perceptions regarding the first three variables: collegial learning effectiveness, expectations for student achievement, and using and promoting student thinking.

In contrast, it is the experienced teachers who show greater improvement in their perceived impact of professional development.

After establishing that there were no significant changes in the changed scores between teachers from different conditions, two groups were selected for the study, as specified in the validity section (table 3).

Table 3
Novice and Experienced Teachers in the Novice and Experienced Groups

		groups based on experience			
		others	novice	experienced	Total
Mixed groups	Others	96	54	52	202
	Group 1	1	4	1	6
	Group 2	2	2	1	5
Total		99	60	54	213

In order to investigate changes between the two groups chosen, an independent sample t-test was performed (see table 4).

Table 4
Changes in Variables for Group 1 and Group 2

	Group	N	Mean	Std. Deviation	Std. Error Mean
Collegial Learning Effectiveness - Pre	Group 1	6	3.43	.34	.14
	Group 2	5	3.20	.58	.26
Collegial Learning Effectiveness - Post	Group 1	6	3.75	.45	.19
	Group 2	5	3.76	.50	.22
Expectations for Student Achievement -Pre	Group 1	6	4.24	.42	.17
	Group 2	5	3.60	.70	.31
Expectations for Student Achievement -Post	Group 1	6	4.07	.31	.13
	Group 2	5	3.77	.76	.34
Using and Promoting Student Thinking -Pre	Group 1	6	3.50	.42	.17
	Group 2	5	3.28	.61	.27
Using and Promoting Student Thinking -Post	Group 1	6	3.56	.47	.19
	Group 2	5	3.50	.73	.33

The analysis shows that group 1 exceeded group 2 in their expectations for the three variables but with no statistical significance. For the two variables 'Collegial Learning Effectiveness' and 'Using and Promoting Student Thinking', the two groups showed improvement in their scores after conducting the lesson study, with group 2 showing a greater change for the better in their expectation although not statistically significant. For the third variable 'Expectations for Student Achievement', group 1 showed a small decrease in their expectations whereas group 2 showed a small increase in their expectations although not statistically significant.

Because of the small sample size, a Mann-Whitney analysis was performed, however no statistically significant results were found. In addition, to look into the change of the three variables for each individual teacher, a descriptive analysis was performed as well (see table 5).

Table 5
Changes in Variables for Individual Teachers

Teacher	Collegial Learning Effectiveness - Pre	Collegial Learning Effectiveness -Post	Expectations for Student Achievement -Pre	Expectations for Student Achievement -Post	Using and Promoting Student Thinking - Pre	Using and Promoting Student Thinking - Post
Nichole (20)	2.40	3.00	2.71	2.86	2.25	3.00
Sheryl (11)	3.80	3.80	3.14	4.00	3.25	4.00
Emma (6)	2.80	4.20	4.29	4.71	3.67	4.50
Andrea (3)	3.40	3.60	3.57	3.14	3.50	3.25

Josh (2)	3.60	4.20	4.29	4.14	3.75	2.75
Lea (2)	3.40	3.40	3.57	3.86	3.25	2.75
Sharon (26)	3.60	3.20	4.57	4.00	3.25	3.50
Lucy (1)	3.40	4.00	4.43	4.00	4.00	4.00
Karen (5)	3.60	4.00	3.86	3.71	4.00	4.00
Lori (13)	3.80	4.40	4.43	4.57	3.50	3.75
Kate (0)	2.80	3.50	4.57	4.29	3.00	3.38

These results should be read with caution since there is no way of knowing the significance of the changes in scores. That said, some of the changes in the mean scores do not correlate with the qualitative data. Possible explanations for such inconsistency of the changed score for the three variables will be discussed in the limitation section.

FINDINGS

In presenting my analysis, pseudonyms were used for all of the participants and the number of years of teaching experience followed their pseudonyms in parenthesis. When quoting the teachers, bracketed references of the meeting number and the time of the quote in the video were included in the following manner: [Video number, Minute count]. A full account of the meetings can be found in Appendix A and B.

The qualitative analysis began with the analysis of the reflections that were written by the teachers at the end of the lesson study cycle. All the participating teachers from the two groups analyzed wrote their reflections concluding the lesson study experience at the end of the process, responding to a single question described in the methods section. Their reflections ranged between 2 and 6 ideas or points they were getting across, some described in one sentence and some described in a longer paragraph, averaging in 3.7 ideas per reflection. Altogether, 11 reflections were analyzed. Six reflections from group 1 and five reflections from group 2.

The written reflections were a structured approach in the original study which served to help "ensure the compatibility of the data across individuals, times, settings, and researchers, and are thus particularly helpful in answering various questions, questions that deal with differences between things" (Maxwell, 2005, p. 80). These personal documents (Bogdan & Knopp Biklen, 2007) consisted of a first-person narrative

and described the individuals' actions, experiences, and beliefs (Plummer, 1983; Taylor & Bogdan, 1984, as cited in Bogdan & Knopp Biklen, 2007). This provided for a good source of insight since the teachers were given the opportunity to express themselves directly and their account of the lesson study process highlighted not only what they chose to write down but also what they did not choose to talk about, and allow for a good foundation for the emerging themes within and across the two groups. In using an ethnoscience or cognitive anthropology (Spradley, 1979; Werner & Schoepfle, 1987, as cited in Maxwell, 2005), highly structured data collection techniques were used but data were interpreted in a largely inductive manner, with very few pre-established categories (Maxwell, 2005).

Open-coding was used to analyze the written reflections. The goal of the coding was both to break down the data and rearrange them into categories in order to facilitate comparison between things in the same category and across categories (Maxwell, 2005) and to quantitatively track the emphasis that was given to each theme by individuals and groups. The establishment of the main themes for the analysis began by going over reflections from a third group that did not participate in this study, and translating the ideas in the written reflections to parallel construct from the literature, referred to by Maxwell (2005, p. 97) as "theoretical categories" – categories that place the coded data into a more general or abstract framework and may be derived from prior theory or inductively developed theory, usually representing the researcher's concepts rather than the participants' concepts (Maxwell, 2005). When analyzing the end of the meetings

reflections, 6 main themes have emerged. The breakdown of the themes in terms of percentage use for each group can be view in appendix C:

1. **Teachers' math understanding and knowledge** – refers to communications where the teachers exhibit their own mathematical knowledge or lack thereof, questioning what they know, asking questions about fractions, etc. (e.g., "The algorithm for dividing a fraction by a fraction that we're taught doesn't make any sense, it's just 'just do it' kind of a thing. Explain to me why?"; "And that's why it took me a minute too to figure it out").
2. **Instructional skills and strategies** – refers to communications regarding a way of teaching something in class, time spent on an activity, a skill a teacher has when teaching, etc. (e.g., "Don't you think we need to start with one that fits equally just to get the concept across?"; "Lower grade use fraction bars").
3. **Teachers' ability to assess student thinking and understanding** – refers to communications where teachers are attempting to explain students' ways of thinking, students' misconceptions, ways to manipulate students' understanding, etc. (e.g., "I think they don't know what they're being asked and they don't know how to filter out information from the problem"; "They associated that with the spaces, not the lines. Isn't that interesting?").
4. **Theories about group process and collegial learning experience** – refers to communications regarding the collaborative team work of the group (e.g., "There are learning communities and we need to dispense videotapes and share that and discuss what's going on, and share with our colleagues"; "I would love to have the

time where we could all talk together. Pick a math topic and come up with ideas just to share and try in our classrooms").

5. **Insight and positive comments on the lesson study process** – refers to communications that show new learning for the teachers and positive impression of the process (e.g., "You know, our children are the same way. I think we need to spend more time doing that"; "However, they developed really good coping skills. The one with the… finger count, he had his method called "finger count" and it was interesting that they used something that was totally "way out there" and they were able to get the answer and they were happy about that").
6. **Critique on / resistance to / difficulty with the lesson study process** – refers to communications where the teachers did not agree with the process, had trouble following the process, expressed something negative in regards to it, refused to go along with the process, etc. (e.g., "I find this a bit contradictory, they [the manual] are talking about how you're supposed to think about the fractions as numbers - we don't do that in 1st and 2nd grade, we don't make the connection with the fraction line"; "Last week we had a difficult difficult meeting where we couldn't get our focus about… the transition… we're doing what they're telling us and all of a sudden it's on us").

These themes seem to be in accordance with the literature that stresses novices lack of mathematical knowledge (Wong, 2004); experienced teaches' enhanced ability to manage class problems and have a bigger repertoire of instructional strategies (Darling-Hammond, 1995); the degree to which student thinking is stressed in Japanese and

American mathematics classrooms (Stigler et al., 1996); and the collegial interchange, rather than isolation, as the desired norm for teachers (Wong, 2004). The fact that they were repeatedly brought up by the participating teachers affirmed their presence in the lesson study process.

With these themes in mind, I watched the videos which included the meetings of the groups, teaching the designed lesson study, and a debriefing meeting that followed the lesson study. In the group meetings, the teachers learned about the Japanese lesson study, read the Japanese example lesson plans and watched videos of their application in the U.S., and planned their own lesson. For the lesson study itself, one teacher taught the lesson designed by the group whereas the other teachers observed it. In the debriefing, the teachers reflected about their taught lesson.

The interactions between the teachers and the content of their conversations which emerged throughout the professional development cycle was then mapped out, and its content was analyzed, referred to by Maxwell (2005, p. 98) as "connecting analysis" – attempting to understand the data in context and looking for relationships that connect statements and events within a context into a coherent whole (Maxwell, 2005). By using both "connecting analysis" and "theoretical categories", this study was able to provide a well-rounded account, whereas the connecting analysis address the events in a specific context and their connections to each other, and the theoretical categories addressed the issues of similarity and differences across settings and individuals (Maxwell, 2005).

The interactions were then color coded according to the themes which included and built on the themes in the reflections. The color-coding was not used as a very

accurate measure but rather a more intuitive way of making the interactions visibly indicative of the content. It is not a scientific measure but rather a qualitative metric, and should be reviewed with discretion since an inter-reliability process was not performed.

These included, in addition to the 6 themes mentioned above:

7. **Teacher as researcher** – refers to communication where the teachers express a desire to explore a way of instruction further or in a different way (e.g., "If we see the students get it, we can expand next lesson study"; "I might photocopy some of these when we get to fractoins and see what happens with my kids. See if they can hack it").
8. **Student previous knowledge and connections between grade levels** – refers to the teachers attempt to use previous knowledge in the lesson study, understanding what the students already know and building on it, etc. (e.g., "In the 2nd grade we don't relate anything to that, it's a whole other concept. It is confusing for me because I'm probably not setting up for 3rd or 4th grade at all…"; "So, you want to talk about things that have been done before to teach that understanding?").
9. **Instruction and student language** – refers to the teachers consideration of the terminology and language used for the lesson study, reflection on terminology and language in the textbook and tests, etc. (e.g., "And for math in particularly, we have to teach the vocabulary for the test which is the most difficult part because the way things are phrased on the CST is not how they are in the textbook"; "Because it gives you the child impression that there's size… or… it's not the proper terminology… greater and less").

10. **Anticipated student response** – refers to communications where the teachers are attempting to predict students' misconceptions and come up with instructional ways to counter that (e.g., "I think they're going to think it's 1-1/4 because of the 4 parts. So they're probably going to figure that out, how many time that little piece can go in there and will end up having 4 parts"; "They might say it's 4/4. They might say it's 1 plus 3 because they'll fold the meter strip to 3, and then they'll say it's 1-2-3-4").
11. **Expectations for student learning and achievement** – refers to communications where the teachers predict student understanding and the success of the lesson (e.g., "It seems like some kids will get it, they'll see it right away, and other ones are going to try things out, hopefully they'll figure it out, and then other kids, we'll put it up on the board, we talk about it and compare and the student can relate to it and start connecting the ideas"; "They've been introduced to meters […] yeah, they should know. Now, whether they all know and have mastery of this, this is something else…").
12. **Challenges of the educational system** – refers to communications where the teachers express frustration resulting from limitations and obligations of the current American educational system that prevents them from changing instructional implementations (e.g., "We're torn between what we want them to be able to do and what we know they'll get tested on. There's a big gap there"; "With that pacing, some of those first lessons using manipulatives were cut off, so we made the decision to still do that. And that is the one day when you can see all of

the students actually do that, it's usually their best day. And by skipping that, some of them get skipped so we decided not to skip it but then we're always behind according to the guidelines...").

13. **Coach guidance** – refers to communications that are meant to guide the teachers through the process or impart new knowledge and clarifications regarding the process of lesson study (e.g., "I'm wondering why you want to start with something less than a whole, before you present the whole. Because that's something that they know - the whole"; "So what might afford the children if they had a linear, a conceptual linear models?").
14. **Assessment** – refers to communications where the teachers are debating assessment of student achievement or assessment of the success of the lesson study (e.g., "What do we want to see the kids be able to do? Don't we have something that we want to see and that's our goal?"; "That's the intention, now whether it happens, I don't know and I think that's something we can evaluate").
15. **Connecting to real-life experiences** – refers to communications where the teachers attempt to connect the lesson or the instructional strategy to the students' real-life experiences (e.g., "Yeah, and I think it would be useful using real things. I mean, pictures of things but real things. Like you [Josh] say using the kids or boxes of cookies, whatever it is"; "Maybe real-life situations where they have to deal with fractions").

The groups differed in their time management conducting the lesson study cycle. Group 1 met over the course of 3.5 months but had only 3 meeting who lasted between

45 minutes and 4 hours, not including the two lesson studies that they taught and the debriefing meetings that followed. Their meetings were very long and condensed and were supported by a coach who joined them for all the meetings. Group 1's total meeting time was a little under 7 hours.

Group 2 met over the course of 5 months and as per the suggested format met once a week, except for holidays and special school event days. Their meetings lasted between 45 minutes and an hour and a half, for a total of 13 meetings, not including the lesson study they taught and the debriefing that followed. Group 2's total meeting time was about 15 hours.

The breakdown of the lesson study cycles for the two groups is presented in table 6.

Table 6
Lesson study cycles breakdown

Group 1	Group 2
10/15/09 – 46 minutes Presenting the lesson study, going over materials, watching the video.	9/21/09 – 1 hour Solving math problems, explaining their own thinking and anticipating student answers and thinking
11/16/09 – 4 hours Going over the Japanese plan, solving math problems, and designing their lesson study	9/28/09 – 1 hour Going over math problems, discussing their thinking in solving them, and connecting that to teaching and student

	thinking
12/2/09 – 46 minutes	10/5/09 – 1 hour
Lesson study	Looking through the Japanese textbook
12/2/09 – 30 minutes	10/14/09 – 1 hour
Debriefing	Reading the summary of the Japanese LS and watching the video of the Japanese teacher teaching the lesson and going over discussion questions from the manual
12/2/09	10/19/09 – 1 hour and 15 minutes
Second lesson study	Watching the second videotaped lesson and discussing it
1/27/09 – 2 hours	10/26/09 - 1 hour and 15 minutes
Summarizing the lesson study experience	Choosing a focus for the lesson study
	11/9/09 - 1 hour and 15 minutes
	Going over the prescribed lesson study and choosing a topic and a grade level to teach
	11/16/09 - 1 hour and 30 minutes
	Choosing a topic to teach
	12/7/09 – 1 hour
	Deciding on goals for the lesson

	1/4/10 - 1 hour and 10 minutes Planning the lesson study 1/14/10 – 46 minutes Planning the lesson study 1/21/10 - 1 hour and 15 minutes Planning the lesson study 1/28/10 – 45 minutes Lesson study 1/29/10 – 47 minutes Debriefing 2/19/10 - 1 hour and 30 minutes Summary and reflections

Group 1

The group, which was located in a wealthy suburban area, included 7 teachers, all female. Four teachers were novices - had 5 years of teaching experience or less, and Two teachers were experienced - had 15 years of experience or more. The lesson study cycle was introduced and guided by one of the teachers in the group who had 18 years of teaching experience and more than 5 years of lesson study experience. She did not participated as a study subject in the original study since she was serving as a coach for the group, and thus, did not fill out any of the written material, including the surveys and

the written reflections. None of the other teacher had any experience in lesson study and they all got involved in it as a part of an instruction improvement program of which they were a part. The group's participants are presented in table 7.

Table 7
Group 1 Participants

Name	Years of teaching experience	Years of lesson study experience
Kate	0	0
Lucy	1	0
Sharon	26	0
Karen	5	0
Lori	13	0
Lea	2	0
Deborah (coach)	18	5+

Group Process and Interactions

Figure 1 describes the breakdown of the time the group spent on each theme emerging from the literature and the videos, which can also be found in appendix C. This group spent the bulk of their time discussing instructional strategies (32% of the total time). They also spent a large portion of the time discussing student thinking (14% of the total time), bringing up new insight and positive comments (19% of the total time), and

being guided through the process (12% of the total time). This section will attempt to analyze the videotaped meetings and the written reflections in light of these themes.

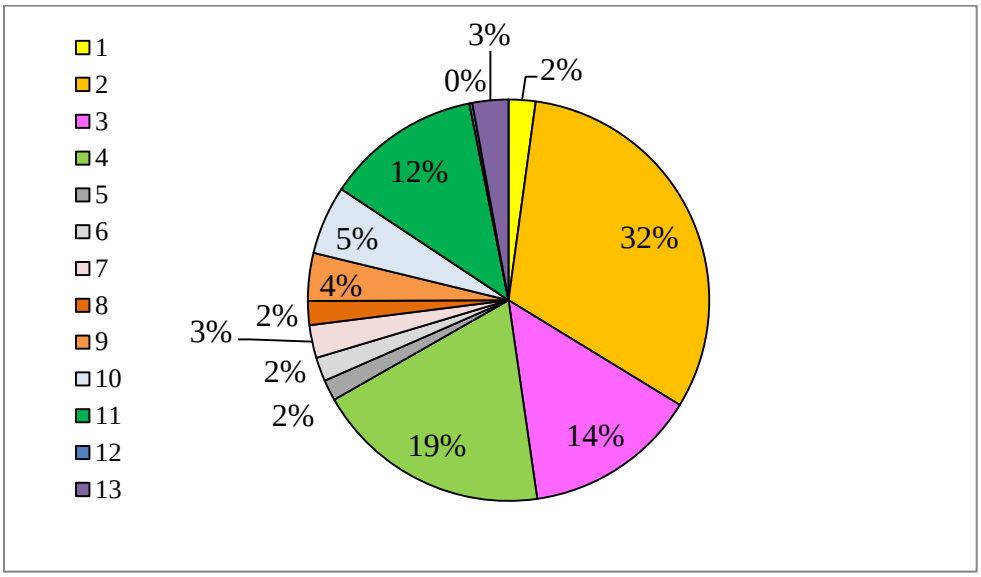

Figure 1. Group 1 Time Spent Breakdown

1 - Teachers' math understanding and knowledge
2 - Instructional skills and strategies
3 - Students' thinking and understanding
4 - Insight and positive comments on the lesson study process
5 - Teacher as researcher
6 - Student previous knowledge
7 - Terminology / Language
8 - Anticipated student response
9 - Expectations for student learning and achievement
10 - Challenges of the educational system
11 - Coach guidance
12 - Assessment
13 - Group process and collegial learning experience

Guidance

The lesson study cycle began with Deborah (18), an experienced teacher serving as the group coach, presenting the concept and materials of the lesson study and showing a video of another group conducting a lesson study on the topic of fractions – the same topic that the group will work on using a specially prepared toolkit from the researchers who designed the study. Her presentation of the process was very positive and it seemed like she was trying to get the group excited and motivated about conducting the lesson study ("This is a really cool opportunity to be able to do this", "This is just really cool background information for you to look at", "They [the researchers] have put together the Japanese curriculum for us to look at. We don't have to use it but we can […] use it and maybe modify it for our kids") [2, 1:00].

Familiarizing with the Japanese Lesson Study

Watanabe's (2001) detailed account of the similarities and differences in the Japanese and American mathematics textbooks really came alive watching the videos of the teachers encountering the Japanese teacher's manual and textbook for the first time. As they were introduced to the Japanese textbooks, the teachers were surprised as to how thin and unintimidating to the students they were, as opposed to the American textbooks. The teachers really liked the Japanese student's textbooks and their comments suggested that they would be happy to make similar changes to the American textbooks:

> Sharon (26): I think it teaches more of the different modalities in the classroom when you have a book like this rather than a textbook with a full page of text. 75% of your kids are EL [English Learners] so if it's like that they're able to grasp it better. And it's also why they like the hands-on, the manipulatives [7A, 22:00]

> Karen (5): You know, I really like these books. They don't put a lot of pressure, there's one concept with 3-4 questions [3C, 54:00]
>
> Lucy (1): We noticed in the textbooks how many pictures there are there and how they will spend a whole day just on one page out of the whole book. Their book is much thinner in compare to ours [7A, 20:00]

In contrast, the Japanese teacher's manual, was very thick and elaborate, and intimidated the teachers who were encountering it for the first time. When concluding the process, the teachers admitted they did not look through the manual because of the binder's size and the teachers' lack of time.

Teachers' Own Math Knowledge

The second meeting included going over the Japanese lesson plan and designing the lesson that the group will later teach, but started with the teachers solving the math problems themselves and discussing their solutions and their math knowledge and thinking. As the literature stresses the teacher's own knowledge and understanding of the subject taught as the basis of good instruction (Lappan & Theule-Lubienski, 1994; Even & Tirosh, 1995; Cooney, 1999), the lesson study gives priority for the deepening of teachers' math understanding by allowing the time within the process through which the teachers do the same mathematical problems that their students are expected to. Through this process they see their own different ways of thinking and anticipate students' responses, they experience the struggle to solve the problems, and gain a better understanding of the mathematical concepts and procedures. It gave them a safe environment to express difficulties without the fear of being judged:

> Lori (13): This is hard… [3C, 33:00]

Deborah (18): Now I know how kids who don't understand feel… [3C, 33:00]

Anticipated Student Response and Student Thinking

The teachers then looked over students' answers of the same problems and discussed the wide range of anticipated student responses provided in the Japanese manual. It helped them to understand better the students' thinking and allowed them later to plan their own lesson, anticipating more possible student responses and misconceptions to address 'on the fly' in the lesson itself. There were definitely some 'aha!' moments occurring at this early stage of the process:

> Deborah (18): You can see what they did and it says a lot about how we are trained. And we still do that because nobody gave us THAT kind of understanding of fractions [3C, 5:00]
>
> Lea (2): I feel like I got my understanding from teaching… [3C, 5:00]
>
> Sharon (26) [Surprised about some of the answers]: The student thinking behind of these answers is very interesting. We assume they just don't understand fractions but maybe they don't have the knowledge of HOW to solve to begin with… [3C, 8:00]

As they were solving the problems and sharing their solutions, they came to the realization that just like them, their students have different ways of thinking, that some need a little more time than others, and understood the benefits of the Japanese system, that uses an entire class to solve one problem:

> Lori (13): That's why it took me a minute too to figure it out" [3C, 41:00]
>
> Deborah (18): And it's not that any of you are wrong… It's just different thinking [3C, 40:00]
>
> Lucy (1): They do one page for a 45 minutes period… so they would literally teach this [showing a page] for 45 minutes… [3C, 44:00]
>
> Karen (5): And it's worth it though [3C, 44:00]

Limitations Rooted in the American Educational System

Throughout the meeting, the teachers were comparing the Japanese instructional strategies to their own and connecting some difficulties in applying them to the way mathematics is taught in the U.S. and the way the American educational system is set up, which, at times, caused them to express doubt about the success of some of the elements in the Japanese lesson for American students:

> Deborah (18): This is great because we don't think about this very much [3C, 18:00]
>
> Sharon (26): No, we don't! Because we're so structured as to "teach the lesson, give the questions… [3C, 19:00]
>
> Karen (5): The pacing guide… 'Keep moving…' [3C, 19:00]
>
> Sharon (26): And we have 31 students… [3C, 19:00]
>
> Karen (5): I'm sure if each of us was given the chance to teach this for 2 months, all the kids would understand and have fun with it, but the problem is we don't have the time [3C, 19:00]

> Karen (5): However, there are questions who focus on concept more than standards and this is where our kids won't like it because they're like 'ok, I learned the rules, I learned how to add and subtract, but my teacher is going to teach me how to think…' [3C, 57:00]
>
> Lea (2): Yeah, we never do that… We tell them 'this is what you do: step one, step two…' [3C, 58:00]
>
> Karen (5): And even if we give them enough time: 'here, think, do' - 5 minutes tops. If they didn't get it, 'here you go' [3C, 58:00]

Expressing these concerns and frustrations led the teachers to think of a way to promote change in the educational system:

> Sharon (26): [How we do it is] computation rather than thinking [3C, 12:00]
>
> Karen (5): And that's exactly the problem" [3C, 12:00]

> Lucy (1): Is this study something we can present to someone on the state department of education that shows that this kind of teaching is more beneficial than what we have? [3C, 58:00]
>
> Karen (5): It's maybe something to be considered later because people will look at it right? [3C, 59:00]
>
> Deborah (18): But you need to do that as a team. It's not something that you as an individual can decide even if you think you should… It's hard. It needs to be district or at least school wide [3C, 59:00]

Instructional Strategies

As the teachers started planning their lesson, using examples from the Japanese textbooks and video and their own experiences, they engaged in an elaborate discussion on instructional strategies. In fact, instructional strategies took the bulk of the discussion time for this group and comprised of 32% of the total discussion time throughout the entire lesson study cycle. They discussed the strategies they observed in the video and the way the teacher handled the class through or despite these strategies, their advantages and disadvantages, and how applicable they can be for them:

> Sharon (26): I've never seen the explanations of how students think before [3C, 17:00]
>
> Karen (5): I like it because you know what to target already [3C, 17:00]
>
> Karen (5): Beautiful lesson… he prompted them, he showed them, he didn't start out the way we do… [3D, 32:00]
>
> Lea (2): And he let them experiment first and then asked them how they got their answer and they had to explain it [3D, 33:00]
>
> Lori (13): It seems like they went all the way through because they were able to write their answers in their journals so they were able to finish the question and write it down [3D, 33:00]

Teaching the Lesson

The teachers then discussed how they want to tweak the model Japanese lesson to fit their own:

> Lea (2): Don't you think we need to start with one that fits equally just to get the concept across? [3D, 33:00]
>
> Karen (5): Do you think we should prompt them the way he did too? It depends if we're doing 4th grade or 1st grade… So, did you like what he did? [3D, 34:00]
>
> Karen (5): And do you think we should start with a perfect meter and add the extra part just for the kids to get the idea of how to do it? [3D, 34:00]
>
> Lucy (1): Yeah, I would say start with it and extend it afterwards [3D, 34:00]
>
> Lori (13): So that they're able to compare the other pieces also [3D, 34:00]

As the teachers were planning the lesson, Lea (2), Lucy (1), and Kate (0) voiced their unwillingness to teach the lesson themselves. Lori (13) expressed her concern about teaching the lesson as well and explained:

> I feel like when you're teaching you're more worried about your delivery and if you're doing it properly but if you're watching you can focus on what the students are saying. That's what I wouldn't want to miss out on [3D, 61:00]

Trying to relieve the pressure off the teachers and allowing them to concentrate on the planning without worrying about teaching it, Deborah (18) reassured them:

> We don't need to decide right now who's teaching it but nobody's going be made to teach it. If nobody wants to teach it, I can teach it. The tricky part is not to teach it, it's to actually follow what the plan says and not change it unless it's really falling apart. And the lesson is really just a way to look at our plan, it's not the most important part. This is really important, what we're doing now. So it's the whole process that's really important [3D, 37:00]
>
> And if teaching it is too stressful, you wouldn't enjoy the process… [3D, 61:00]

Eventually, Sharon (26), the most experienced teacher, taught the lesson. The videos did not indicate how she was chosen or the reason for that decision. Perhaps this is an indication that, as the most experienced and as the literature suggests, she does have the class managerial tools to get through an innovative lesson more successfully than her colleagues, or at least the confidence to do so.

Quality of Explanations

The literature emphasizes the Japanese teachers' explanations as a key component for students' understanding of mathematical concepts (Perry, 2000). When the group was watching the Japanese teacher teaching the lesson study to his class, they admitted that his students' ability to explain their solutions and thinking were better than their own students. However, they interpreted their students' difficulty to be a result of the different population of students, most of which are English Learners students:

> Karen (5): We realized that his kids were able to explain how they thought. Our kids knew what to do but they couldn't tell how they reached their conclusions, and it's again a language thing, because most of them are EL [English Learners]. So we knew they got the idea but they couldn't tell us how they got it. So we couldn't really see how they're thinking, so we used our judgment, like babies [7A, 24:00]
>
> Karen (5): They used some statements that we didn't understand and we asked them what did they mean and they kept repeating the same sentence… so it was hard for them to explain but they were showing it with gestures… [7A, 26:00]

This point came up again when Deborah (18) asked if the lesson study experience has changed the way the teachers think about mathematics, and Karen (5) responded: "Maybe explaining math. Not the way we think about math. When we were students we

never thought of math the way we do now teaching. We were like our students, memorizing… so yes, we will change the way we're teaching" [7A, 53:00].

Terminology and Student Thinking

In their planning of the lesson, the teachers took into consideration to a great extent students' thinking (14% of the total discussion time) and also considered, although they did not give it as much attention, their expectations of student learning (4% of the total discussion time), anticipating students' responses (2% of the total discussion time), and previous knowledge (2% of the total discussion time), putting some emphasis on the language to better fit their students and their goals (3% of the total discussion time). Similarly, when revising the lesson study, much attention was given to changing the language used the first time and really emphasizing the goal in that language. This indicates the beginning of a learning process for the teachers to improve their explanations in class. The lesson study facilitated this revision which had not occurred, and perhaps would have gone completely unnoticed, without the structured process of the lesson study:

> Karen (5): Students will be able to identify..? [3E, 17:00]
>
> Lori (13): Understand [3E, 17:00]
>
> Karen (5): Understand is subjective… [3E, 17:00]
>
> Lori (13): Is that not ok? That's how it is in the manual… [3E, 17:00]
>
> Karen (5): Ok, so understand that fractions… [3E, 18:00]
>
> Lori (13): are … and recognize the parts total relationships [3E, 18:00]
>
> Lea (2): Should we say something about the students understanding about the paper strips? [3E, 18:00]

Teacher as Researcher

Some teachers were assuming the 'teacher as researcher' role, looking further ahead and allowing themselves to make a mistake and experiment with the lesson, realizing that that was the point of the process and seizing the opportunity to explore what works and what doesn't:

> Sharon (26): If we see the students get it, we can expand next lesson study [3E, 8:00]
>
> Karen (5) [Since they decided to teach the lesson twice to two different groups]: We wanted to see how it would be with a second group and we changed some stuff… There were some errors in the first [lesson] so we thought 'let's perfect it in the second' [7A, 33:00]
>
> Sharon (26): Even though it was a different population of student, just to see how our kids would react to that. I think we were all rather surprised at the results when the kids got involved in the activity. It appeared that everybody had a part in it [7A, 23:00]
>
> Lori: …Just to see it in action. It was really interesting. And the kids were engaged so it made you want to try it out, see how it worked [7A, 23:00]

Debriefing after Teaching the Lesson Study

In the debriefing, after teaching the lesson, there was an apparent excitement among the teachers. They were very enthusiastic and surprised by the way the lesson turned out. The energy level was up:

> Sharon (26): I thought the kids did a great job! [5A, 0:00]
>
> Lucy (1): I thought it was interesting to see that groups of kids that I didn't think would got the answer right away did get it and some kids that do have more mathematical thinking didn't get it [5A, 2:00]
>
> Karen (5): This made me realize I need to use more of that. They were excited, they were trying to discover things, and we're usually doing it boring… So they were involved… and we didn't group them by ability… [5A, 4:00]

> Sharon (26): I liked how they were all willing to try it. Even though you said you have some students you were concerned about, it really went well. And they were able to come back to where I wanted them to come back [5A, 12:00]
>
> Lea (2): I was surprised that they used that other piece [paper strip]. And that was good because they were able to understand that if they're using one that is 1/3 and one that is 2/3 so that's 3/3 and that's a whole [5A, 4:00]

The teachers raised some aspect of the lesson they did not like, wanted to change, or felt needed tweaking:

> Sharon (26): One thing that was a difficulty was the sign. They had trouble with that. Also because it was written in two different ways, and that's why when I wrote my fractions on the board, I did it both ways so they could see the sign was a little deceptive [5A, 5:00]

One thing that was very apparent was that learning has occurred for the rest of the teachers who were watching Sharon (26) teach the lesson, and the discussion that followed allowed for even more learning opportunities:

> Lori (13): You brought them back to the number line where you started it, and I thought it was good how you showed them, having the students come up, how to do it properly, cause the one student couldn't verbally tell you, so you had him come up and show you how to do it correctly. I thought you did kind of closed it up [5A, 7:00]
>
> Karen (5): I realized that when they used two pieces in a whole they referred to them as halves because they were looking at them as equal parts [5A, 3:00]
>
> Sharon (26): That's why we divided the line on the board to equal parts because they didn't relate this to a line. They needed a little more [5A, 3:00]
>
> Lori (13): You really let them explain it to you and if they were having a hard time you had them show it to you [5A, 21:00]

Another learning opportunity came up when Karen (5) was raising a point, suggesting a change in the instruction, and Sharon (26) responded: “I actually didn't want

to do that because they would have immediately found it. I wanted them to figure it out, but I understand what you're saying" [5A, 21:00].

The literature talks about experienced teachers being able to change their instruction "on the fly" (Meyer, 2004; Freiberg, 2002) and it did indeed come up in the group's discussion:

> Lori (13): I thought it was good. Especially since you did it "on the fly"… How would you do it better? [5A, 20:00]

The last meeting summarized the lesson study cycle and allowed for the most insight into the teachers' thinking and learning regarding the process they went through. In combination with the written reflections and the videotapes, I analyzed each teacher's journey through the process:

Lea – 2 years of teaching experience. What stood out for Lea was how the lesson study and the collaboration with the other teachers gave her the opportunity to organize the lesson more efficiently. As a novice teacher, it seems that Lea needed that guided and scaffold practice of creating a lesson plan with more experienced teachers. This indicated the merit of the lesson study as a good induction tool in that respect:

> You're more focused. When you're doing it on your own you're kind of all over the place, but when you're in a group with a specific goal in mind, you're really focused on that lesson, on that goal, on that topic [7A, 18:00]
>
> We've been doing other professional development and we've been learning how valuable collaborative teaching team is [7A, 17:00]

This focus allowed her to understand a few things about her students that were not known to her beforehand, including students' previous knowledge, student assessment, and student thinking, all affecting her instructional strategies:

> One of the things that stood out the most to me during this process was how well students did on meeting the objective without getting any kind of direct instruction. It makes me think that as a teacher I need to bridge what they already know and are able to figure out on their own to what I am teaching [written reflection]
>
> We're so set in that we need to directly teach them and tell them what to do and give them guidelines, but guess what? They're pretty smart… [7A, 17:00]
>
> It makes me realize that when I am assessing their understanding of fractions or other concepts with just pencil and paper it is not giving me a clear picture of what they actually know [written reflection]
>
> When watching the different student groups it was very obvious that students process things differently. There were different strategies that were used, different correct answers and different ways of explaining answers [written reflection]
>
> They all think very differently and learn differently [7A, 45:00]
>
> It really makes me think of how important it is to present material being taught in a number of different ways rather than just one [written reflection]

Another thing that surprised Lea was the way instruction could be presented to students. The literature talks about "chewing" the material and simplifying it more and more, mostly to ensure that all the students pass the tests (Perry, 2000; Cooney, 1999), instead of challenging them and, as it is in the Japanese classroom, pulling them to higher levels of thinking:

> What surprised me is that even when you don't give them any instructions and guidelines and steps and they can still do it, they figure it out. Because I thought it was going to be a disaster, they're not going to know how to figure it out but they did ok with it [7A, 4:00]

Lea even discovered a new way of explaining a concept to her students that she had struggled with in the past. Through the observation she could focus on students' responses and thinking and realized how she can use their own speech to explain the concept. This, again, indicates the efficiency of the lesson study as an induction tool for novice teachers:

> I thought it was interesting how the students explained it because I have that problem with my students but the one student said: you draw one less line than the fraction and I thought that is a great way to explain it [5A, 8:00]

Through the process and through looking at different models, Lea developed some criticism of the way math is being taught in the U.S.:

> It's not necessarily not having the time for fractions but also jumping from concept to concept. There's not enough time to spend on each concept [7A, 10:00]

Much like the other teachers that were skeptical regarding the students' ability to get through the lesson successfully, Lea was also surprised by the lessons outcomes as performed by the students:

> I thought they did good at explaining it actually. Because they could show you what they did [7A, 25:00]
>
> What surprised me is that even when you don't give them any instructions and guidelines and steps and they can still do it, they figure it out. Because I thought it was going to be a disaster, they're not going to know how to figure it out but they did ok with it [7A, 4:00]

Sharon – 26 years of teaching experience. According to the literature, experienced teachers need less guidance with instructional strategies and managing their class (Darling-Hammond, 1995; Meyer, 2004), so it is not surprising that not much attention was given to that aspect in Sharon's reflection. For her, the biggest aspect of her

own personal growth laid in the collaborative nature of the lesson study. Sharon even went further and suggested what is already being implemented in Japan – to create learning communities that would share ideas and lesson plans and dispense videotapes of taught lesson studies with each other, indicating the strong impression the lesson study had on her and the power of this process as a professional development tool and as an instrument for improving instruction on a bigger scale than just one group in a school:

> The most important thing I learned from this study was the importance of collaborative work for teachers. Having the opportunity to work with colleagues on a lesson was energizing. Also the chance to receive a critique and discussion that was relevant to my own growth as a teacher. I would be very interested in more opportunities to participate in similar group discussions and I will take this to my staff [written reflection]
>
> You know, there are learning communities and we need to dispense videotapes and share that and discuss what's going on, and share with our colleagues [7A, 17:00]
>
> I would love to have the time where we could all talk together. Pick a math topic and come up with ideas just to share and try in our classrooms [7A, 50:00]

Interestingly, Sharon had expressed feeling nervous about joining the lesson study at first, although she did not explain why:

> Our leadership coach told us: why don't you look into lesson study and start observing new lessons and that how we got drawn into it. And I was nervous about it but I was fine. And I enjoyed it. And I would love to see more teachers go observe teachers [7A, 14:00]

In addition, Sharon was very impressed with the hands-on activities and their effect on the students' understanding of the topic:

> The hands on lesson should be the rule rather than the exception [written reflection]

However, this caused her to express frustration as to the way mathematics is being taught in the U.S., stemming from time limitations dictated by higher ranks:

> One thing it made me realize is that, sadly, we are tied to a pacing guide and in prior years, like 10 years ago, I was able, time wise, to use more […] than I do now, and I think it's a loss for the students because it gives them more of a practical way to look at their math rather than paper and pencil that are right in front of you and just do it, and I'd like to be able to do that more, start using manipulatives [7A, 7:00]
>
> We're torn between what we want them to be able to do and what we know they'll get tested on. There's a big gap there [7A, 28:00]
>
> I think we need to spend more time doing that. I know I did it with one lesson but I didn't do it enough, I felt that I had to move on. The sense that we're always feeling like we've got to move on… there's a lot of pressure [7A, 47:00]
>
> We have to teach the vocabulary for the test which is the most difficult part because the way things are phrased on the CST is not how they are in the textbook [7A, 52:00]

Lucy – 1 year of teaching experience. In her written reflection, Lucy stated how beneficial the lesson study has been for her, allowing her to discover new instructional strategies ("Working with hands on materials in an open-ended activity really does benefit my students"); student thinking ("They were able to see the concept a lot better by working on it themselves"); and the collaborative process ("I found great value in collaborating with my fellow teachers. By discussing everything together, we were able to design a very successful activity. The collaboration afterwards was extremely beneficial as well. Every person here had so many amazing ideas and theories to share. I think I learned a lot from each of them").

Lucy even mentioned how the hands-on lesson contributed to her students' understanding later on and how it had shaped the way she will teach in the future:

> Karen (5): You said it made a difference later when you introduced fractions, right? [7A, 4:00]
>
> Lucy (1): We were in the middle of doing fractions in our math book and it [the lesson study] made the introduction easier to refer back to [7A, 4:00]
>
> Lucy (1): Also, this study itself gave me the perspective of letting the kids have more self-discovery through activities first before diving into the lesson because it does make a difference. And we have some manipulatives and that and self-discovery really helps them [7A, 6:00]

Through the process, Lucy has developed a deeper understanding of her students' abilities and the teaching she can do to get them further ahead:

> I also feel that finding other approaches to teaching fractions is valuable. Students don't always learn the way a book presents the information. I think representing fractions by solving them with pictures and number lines is setting them up for success. These various approaches will help my students in the long run achieve in math. This will also give them exposure to number lines ahead of time, which will make learning of other concepts easier [written reflection]
>
> There was no pressure for them to have the right answer and even though some of them felt like they needed to have the right answer, they were all trying it out. None of them were sitting there intimidated by the task, sitting there thinking: "I don't know what to do". I think they all took on the challenge [7A, 45:00]

It seems that for Lucy, as a novice teacher, the lesson study was a very beneficial induction tool that promoted personal growth and confidence.

Karen – 5 years of teaching experience. Throughout the process, Karen was very talkative and an active and enthusiastic participant. It was evident that she enjoyed the process and was very happy with the results. Her appreciation for the collaborative process was evident in her remarks, and she even wanted to take it further and make it a permanent practice:

> We always shared but we never had the chance to observe and discuss the differences between prior and after. […] It was a new experience and we all know that it is a good idea to do this so we went forward and did it [7A, 13:00]
>
> It's a very good thing and maybe we should… maybe we need to talk to [supervisor] about it… Yeah, we have to because we learned a lot. I've never had a chance to go to a 4th grade class [7A, 13:00]
>
> And you get input from other teachers as well because we always teach the way we learned but when we watched the tape we were like: 'oh, that's great. Let's use that'. So, more inputs, more ideas [7A, 18:00]

In her reflection, Karen expressed her satisfaction of the lesson study process and the importance of observing other teachers, collaborating and sharing ideas, and reflecting to make instruction better:

> I learned how important it is to collaborate with other teachers. We shared many ideas and learned from each other [written reflection]
>
> This lesson study had also shown me the importance of teaching and reflecting on what I had taught to make the instructions better and of course promote student thinking. This had made me think of how essential it is to observe other teachers and take as many ideas as possible to integrate it in my classroom [written reflection]

Her reflection also noted the shift in the instructional thinking she had before, and showed her the different responses to math that she can get out of her students:

> They [the Japanese textbooks] focus on skills more than on concepts. They [the Japanese] want them [the students] to know what to do. For us, they're almost memorizing math… and this is what's helpful because if a question is asked a different way, they'd be lost. With those books it's skills so no matter what, they'll learn the skill and they will know what to do. The kids know what to do... the kinds of questions are different as well. For us it's like... I don't know... Let's use those books! [7A, 20:00]
>
> I learned how important it is to provide students with hands-on activities and how essential it is to provide opportunities for students to explore and discover. All of us were very pleasantly surprised to see and discover how students collaborated and worked together to reach their conclusions [written reflection]

> The lesson was great where students were highly motivated. They were excited to explore and reach conclusions. They were very engaged since they were not worried about being wrong [written reflection]
>
> I remember, I had a teacher that used to look at our entire answer, even if the answer wasn't right, we could get point for the way we solved it. We don't look at that, only at the final answer. So maybe we should work on that as well as teachers, look at the way they thought, the process and score them on that as well. This will let them work harder as well because they get frustrated. Some of them fall behind because of calculations… [7A, 29:00]

In addition to the collaborative process, instructional strategies, and student thinking, which were evident in the other reflections of the teachers in the group, Karen added her own mathematical thinking as a valuable lesson she had learned:

> This lesson study had shown me that fractions are not only fractions, but rather that can be related to percents, decimals as well as measurements [Written reflections]
>
> The thing with the strip, we tried to do it ourselves and maybe 2 of us figured it out [7A, 43:00]

Lori – 13 years of teaching experience. In her written reflection, Lori expressed her satisfaction from the collaborative process, calling it "an extremely valuable experience", which suggests that even with 13 years of teaching experience, teachers could learn from one another and improve their teaching through this process:

> I really would like to work with my colleagues to incorporate these types of problem solving tasks in to our math program. It is difficult to think about alone (considering our pacing guide) but I think that together we could make it work. We talk and share ideas informally (at lunch) but it was great to plan, share and reflect together. Also watching a colleague teach was great. I learned a lot from that experience as well [written reflection]
>
> Maybe if you didn't know the people it could be uncomfortable but I felt that we were all comfortable so you can say things and not feel like you're being judged [7A, 19:00]

> …To watch other people teach too. We never get to see what other people do. It's weird, this is a profession where you talk about it a lot but we never get to see how it's really done and it was interesting to see that [7A, 14:00]

Her understanding of student thinking has deepened through watching the students work and seeing their abilities come through with the hands-on activity that was new to her:

> I realized that students no matter what the limitations (language, etc.) can exceed your expectations. We observed that in our lesson [written reflection]
>
> During the lesson study I thought it was interesting to see the different groups and how they solve, the strategies that they used. And some kids assumed a role, like a leader, and you don't usually see this when you're doing procedural math problems. So seeing them work together is something that I probably need to do more of to see that group work [7A, 3:00]

Lori also expressed concern regarding student assessment:

> But then what happens is when they showed us, they were doing it physically correct but then when they were expressing it in an incorrect way [7A, 36:00]
>
> And we give them a pencil and a paper and they fail… and they knew it in class and it's because we heard it but the test is not showing that. So that's the hard part - how do you assess…? [7A, 27:00]
>
> We already have the… preparing them for the CSTs with our testing… Maybe what we need to do is to add some of that hands-on culminating group activity… We can't take away our chapter tests but maybe we need to add more of that type of thing. So that their grade will not be only about what they do on the test but a little more... [7A, 29:00]

Finally, her view of instructional strategies has changed as well:

> I learned that allowing students to explore to solve open ended math questions is extremely important [written reflection]
>
> These kids [the weaker students] are usually really good on the hands-on days. That's their best day because they don't have to explain or write things down. They can just show and their answer would be right there [7A, 41:00]

> It made me realize that I want to do that, I just have to figure out how I'm going to do it. And I do have a book with open-ended questions, but it like: 'how do I fit it in? Where do I fit it in?'. And that maybe can be something we can all figure out because I don't know how by myself. But I realized, not only is that important but I want to do more of that, have that experience. I'm just not sure how [7A, 50:00]

In the conversations with the group, Lori was also talking about her own mathematical knowledge. Since the teachers themselves were struggling to solve the math problem, she later admitted:

> This is why we thought it was a good problem because even we couldn't do it [7A, 44:00]
>
> We did different things, and it's the same thing [with students] because that's not how we're used to do things, that's not how we usually do math.. Or teach math... So were probably a little rusty at that… [7A, 43:00]
>
> There's the math procedure, and there's the computation, and there's the math concepts. So I feel like what we've done with the lesson study is more about the math concepts. And I have to admit I'm kind of rusty because I've been focused on the procedures and computations and I haven't been teaching this way so it's showing me that I don't know how but somehow you have to like: "what is the concept, and don't forget what is the main concept of the math lesson [7A, 53:00]

Kate – 0 years of teaching experience. Throughout the process, Kate was a very passive participant and, for the most part, did not actively join the discussion. As a new teacher, it is not surprising that most of Kate's written reflection concentrated on instructional strategies:

> One of the most important things I learned from the lesson study (or further confirmed) was the need for exploration-based activities when teaching math. Students thrived when given manipulatives to compare fractional parts. Students demonstrated an understanding of the objective through several different ways. This showed why hands-on activities are important in teaching in order to reach all students learning modalities. Having students work in a group activity for a math lesson is also important because students are able to talk about and use mathematical vocabulary which supports their development of English language [written reflection]

An interesting comment in her reflection confirmed her low active participation in the discussions with the group. This further confirms the high need of novices with no previous teaching experience to be a part of a more knowledgable group in order to learn from their experience and apply their knowledge in their teachings:

> I would also like to maintain collaboration with other grade level colleagues to further improve my teaching practices. I enjoy hearing their ideas and suggestions [written reflection]

Kate also acknowledged the importance of the lesson study, especially for her, as a beginner teacher in the concluding conversation with the group:

> With the fraction it was SO important and especially being first year teachers, we just work from our textbook, and have that prior knowledge of the lesson for our group of kids because we haven't talked about it yet, it was really helpful. And also, it gave us that jump start of seeing how it works [7A, 6:00]

Themes Emerging from the Group's Lesson Study

The majority of the observed videotaped meetings were spent discussing instructional strategies (32%) and student thinking (14%), as did the reflections (see appendix C for the breakdown of the themes in terms of percentage use for each group). However some interesting topics came up in the conversations that uncovered the teachers learning and thinking.

New ways of thinking of instruction. The teachers were introduced to a different way of instruction than they were used to. The structure of the experience, being a part of a scientific study, allowed them to experiment with these new ideas in a safe environment. Whether they were expecting chaos or they were not sure what to expect,

the lesson study provided them the opportunity to try out these new instructional strategies, something that they would not have otherwise done:

> Sharon (26): I've never seen the explanations of how students think before [3C, 17:00]
>
> Karen (5): I like it because you know what to target already [3C, 17:00]
>
> Deborah (18): This is great because we don't think about this very much [3C, 18:00]
>
> Sharon: No, we don't! Because we're so structured as to "teach the lesson, give the questions… [3C, 19:00]
>
> Karen (5): You know, I really like these books. They don't put a lot of pressure, there's one concept with 3-4 questions [3C, 54:00]
>
> Lea (2): Yeah, we never do that… We tell them "this is what you do: step one, step two… [3C, 58:00]
>
> Karen (5): But beautiful lesson… he prompted them, he showed them, he didn't start out the way we do… [3D, 32:00]

The literature points to the difference in teaching styles where American teachers focus on the procedures; the teacher as the authority; and the notion of only one correct answer, as oppose to Japanese teachers, who allow more time for each question; and endorsing the notion of multiple solutions (Stigler et al., 1996). The teachers did realize that just as they are teaching a certain way; their students learn a certain way. And to change their students' thinking and approach to mathematics requires a shift in the instruction itself:

> Lea (2): Yeah, we never do that… We tell them "this is what you do: step one, step two… [3C, 58:00]
>
> Karen (5): And even if we give them enough time, here, think, do - 5 minutes tops. If they didn't get it, 'here you go' [3C, 58:00]

Even though the teachers did expect chaos, they were surprised with the lesson study results and drew their conclusions from it:

> Lucy (1): There was no pressure for them to have the right answer and even though some of them felt like they needed to have the right answer, they were all trying it out. None of them were sitting there intimidated by the task, sitting there thinking: 'I don't know what to do'. I think they all took on the challenge [7A, 45:00]
>
> Lori (13): Even the groups that seemed to have a hard time starting, once they started, if you asked them what did they do, they all had something to say and they all tried different things. It was really interesting [7A, 46:00]

Student tracking by ability. Throughout the discussions, the teachers attributed changes between their students and the Japanese students to the differences in populations. Interestingly, when teaching the lesson study to the class, the teachers did not prepare in advance to group the students in any particular way. Later, they expressed their surprise regarding the success of the lesson despite the random grouping, which led to an interesting conversation about assigning higher and lower students together:

> Karen (5): I realized the big difference in the population of the students. We were watching them and think, there's no way we can do it this way but we were surprised because they did better than we had expected. They are better students than we think, they just need the time [7A, 16:00]
>
> Sharon (26): Even though it was a different population of student, just to see how our kids would react to that. I think we were all rather surprised at the results when the kids got involved in the activity. It appeared that everybody had a part in it [7A, 23:00]

On the concluding discussion, it was apparent how deep the 'invisible cultural way of instruction' (Hiebert & Stigler, 2000) runs, however the opportunity to discuss it within the lesson study resulted in a very interesting conclusion:

> Lucy (1): Also splitting the groups. Ideally you'd want to have mixed groups and we lucked out with mine that they're kind of sitting around each other in mixed ability, but if you're teaching you want to make sure you're not putting 4 kids together that all struggle with division because then they'll be lost [7A, 41:00]
>
> Lori (13): Yeah, so maybe an assigned group? [7A, 41:00]
>
> Lea (2): It would be interesting though… [7A, 41:00]
>
> Lori (13): It would but when you're trying to have mixed ability [7A, 41:00]
>
> Deborah (18): I wonder about what you said earlier that they can do a lot more than we think they can do, what would happen if we did put them… [7A, 41:00]
>
> Lea (2): That's what I'm saying, because some of those kids are used to depending on the higher kids so it would be interesting to put them in a group where… [7A, 41:00]
>
> Lori (13): Yeah. And these kids are usually really good on the hands-on days. That's their best day because they don't have to explain or write things down. They can just show and their answer would be right there [7A, 41:00]
>
> Lea (2): And I think these kids are used to taking a back seat to the kids who tend to perform well so in a group situation they can very easily just sit there and not say anything and go along with the leaders so maybe creating a group and putting these kids together where they have to figure it out on their own... [7A, 42:00]

This resulted in drawing conclusions for future instruction:

> Lori (13): And every year the kids struggle. So now we know. First thing we teach the… It's either or… it's the same thing [7A, 52:00]

Limitations rooted in the American educational system. The teachers have been expressing their frustration regarding the pacing-guide and 'teaching for the test', stating that it is sometimes "overwhelming" for them and mentioning that sometimes they have to ignore it in order to build student knowledge for the next topic. From their conversations, it seems that they feel that the emphasis, dictated by higher ranks in the educational system, is on the students' scores and not their learning. Important learning activities have been cut out because of time limitations, and students' understanding was

not complete before moving on to the next topic. This put an extreme pressure on the teachers:

> Sharon (26): We're torn between what we want them to be able to do and what we know they'll get tested on. There's a big gap there [7A, 28:00]
>
> Karen (5): We want to teach them but at the same time we want them to do well on the test. Especially since we are under the improvement program so we need them to do well [7A, 28:00]
>
> Sharon (26): One thing it made me realize is that, sadly, we are tied to a pacing guide and in prior years, like 10 years ago, I was able, time wise, to use more […] than I do now, and I think it's a loss for the students because it gives them more of a practical way to look at their math rather than paper and pencil that are right in front of you and just do it, and I'd like to be able to do that more, start using manipulatives [7A, 7:00]
>
> Lori (13): With that pacing, some of those first lessons using manipulatives were cut off, so we made the decision to still do that. And that is the one day when you can see all of the students actually do that, it's usually their best day. And by skipping that, some of them get skipped so we decided not to skip it but then we're always behind according to the guidelines... [7A, 8:00]
>
> Kate (0): And still I wish we could spend more time on it because it's hard knowing that a lot of the students still don't understand it [7A, 9:00]
>
> Lucy (1): And we have to move to decimals and if they don't understand fractions they won't understand decimals [7A, 9:00]

The teachers were also surprised to realize how individual and isolated the teaching profession is, not having the chance to see how other teachers are approaching different topics and situations in class and not being able to share ideas:

> Lori (13): To watch other people teach too. We never get to see what other people do. It's weird, this is a profession where you talk about it a lot but we never get to see how it's really done and it was interesting to see that [7A, 14:00]
>
> Karen (5): Actually we were thinking about videotaping ourselves. Even if we can't go observe we can watch ourselves and see what our strengths are, what you need to work on, otherwise, there's no way you can tell… [7A, 15:00]
>
> Lucy (1): I did that last year and it taught me a lot about things I wasn't aware of, things that were good, and things I should change [7A, 15:00]

This individuality characterizing the American teaching profession (Stigler et al., 1996; Hiebert & Stigler, 2000) also came across when the teachers had the opportunity to follow a prescribed lesson but chose to create their own:

> Sharon (26): But we didn't go into that too much, we created our own. We probably… could have used that… [7A, 23:00]

Student assessment. Another example of the 'invisible cultural way of instruction' (Hiebert & Stigler, 2000) could be seen through a conversation about student assessment which shows how hard it was for the teachers to let go of the formal assessment and try something new:

> Karen (5): I would put also a formal assessment other than informal assessment maybe with objectives in mind [7A, 37:00]
>
> Sharon (26): But then you're going back to paper and pencils which was not what we were trying to do [7A, 37:00]
>
> Lea (2): They can have both [7A, 37:00]
>
> Karen (5): Because think about it, in normal life they always end up having a formal assessment [7A, 37:00]
>
> Sharon (26): No, in SCHOOL, they always end up having a formal assessment [7A, 38:00]

Concluding Thoughts

Overall, it seemed that the teachers were enjoying the process and the new material and examples they encountered. The atmosphere of the group was very open and comfortable, and the language that was used was very positive and supportive ("Does everyone agrees?", "Everybody's happy with this?", "Does that make sense?"). Some teachers were considerably more dominant in the discussion than others, but these teachers were both novices and experienced. Even though at times it seemed like the

more experienced teachers are guiding the planning of the lesson and offering valuable input that is emanating from their experience, no trend of communication was found in the videos where the experienced teachers had more "communication time" than the novices or vise-versa. In fact, it seems that the novices had a different quality to offer in the collaboration since they were not fixed on one method of teaching and were willing to take risks with new educational strategies. However, at times, it seemed that Kate (0) and Lucy (1) were talking amongst themselves, drifting away from the groups' discussion.

In addition, Kate (0) was considerably quieter than and not as talkative as her colleagues. It is possible that her being a new teacher who never taught prior to that year, limited her input and suggestions to the group, stemming from lack of real-life experience to draw from. It could also stem from the relatively large size of the group, although it seemed like she felt comfortable with her colleagues and did not hesitate to say something when she wanted to. Perhaps in a smaller group, all participants would have been able to put more of their input in while in a large group, by nature, some are heard more and some are heard less. Still, perhaps being the "new kid on the block" does put her in a more defensive position, as the literature indicated for novice teachers in a more experienced group (Stafford-Plummer & Peterson, 2009). An alternative explanation could be a personality issue. Some people are more open and talkative, as can be seen very clearly from the rest of the group.

Karen (5) took on the role of the group's transcriber and was typing the protocol and the lesson plan on her laptop. She did not, however, hide behind that role in any way.

She was engaged and immersed throughout the entire process and had a lot of input in the conversation.

It seemed that all of the teachers saw the benefits of the collaborative collegial learning since they all expressed their desire to continue that process in the future.

Throughout the lesson study cycle, Deborah (18) was offering a lot of guidance and reassurance all the while keeping her input and opinion about the lesson planning to a minimum. For example, when the teachers were choosing the goals of the lesson, she referred them to the Japanese manual that offered suggestions and examples of goals for a fraction lesson but refrained from steering them towards a specific recommendation or course of action. It seems that having a strong leader in the group contributed greatly to this group's outcomes.

It seemed that the lesson study process allowed the teachers to explore an activity that they otherwise would not have felt comfortable trying. The teachers repeatedly said that they were teaching a certain way and did not even think such an approach would be successful. They were expecting chaos in the classroom and would not have attempted such an activity if it weren't for the lesson study which allowed them for the exploration of a new activity in a safe environment without judgment but rather the support of their colleagues. Furthermore, it seemed that they found a way to turn some of their students from weaker to stronger through the hands-on activity.

In addition, it allowed them the time to debate instructional strategies, student thinking, and anticipated student responses, as well as debating the outcomes later:

> Lucy (1): We could've given each group a different problem to solve and have them solve it and then come up in front of the group and showed it and that way

> they were visually showing what they did and that would have been more formal because then everyone would have done one problem [7A, 38:00]

An interesting comment Deborah (18) made was about the group's involvement and enthusiasm regarding the lesson study:

> What was interesting to me was when you started out you were going through the tool kit and were like "whatever", and then started to go over the scripts and you were getting more involved and more excited so that was really interesting to watch [7A, 46:00]

It speaks volumes to the lesson study process that, despite the long hours and hard work, the teachers were drawn into the process and were engaged in it in such a positive way.

Group 2

The group, which was located in a low socio-economic urban area, included 5 teachers, four females and one male. Two teachers were novices - had 5 years of teaching experience or less, and one teachers were experienced - had 15 years of experience or more. The lesson study cycle was somewhat guided by one of the teachers in the group – Sheryl (11) – who had some lesson study experience (1-2 cycles) and organized the lesson study group in this school. She was the contact person to the researchers and within the school staff and, among other things, she was responsible for recruiting the group members; made sure that both high status and low status teachers participated; and asked for specific support regarding the materials in the tool kit when needed. When the group had trouble progressing, she used her previous lesson study experience to move the

process forward. Other than Sheryl (11), Emma (6) was the only teacher with some experience in lesson study (1 previous cycle) and none of the other teacher had any experience in lesson study. In addition, the group was supported by Bonnie - a math-science instructor of preservice educators and a member of the original study's research team, who served as the group's coach and whose level of involvement was at the group's request. Group 2 also conducted a lesson study on the topic of fractions using a specially prepared toolkit from the researchers who designed the study. The group's participants are presented in table 8.

Table 8
Group 2 participants

Name	Years of teaching experience	Years of lesson study experience	Grade level
Andrea	3	0	4th grade
Josh	2	0	3rd grade
Emma	6	1	3rd grade
Nichole	20	0	2nd grade
Sheryl	11	1-2	1st grade

Group Process and Interactions

Throughout the lesson study cycle, the group used the recommendations in the teacher's manual and followed the prescribed process as it suggested, since they did not

have a sit-in coach to guide them through it. Figure 2 describes the breakdown of the time the group spent on each theme emerging from the literature and the videos, which can also be found in appendix C. This group spent the bulk of their time discussing instructional strategies (36% of the total time). They also spent a large portion of the time discussing student thinking (12% of the total time) and their own math knowledge (12% of the total time). This section will attempt to analyze the videotaped meetings and the written reflections in light of these themes.

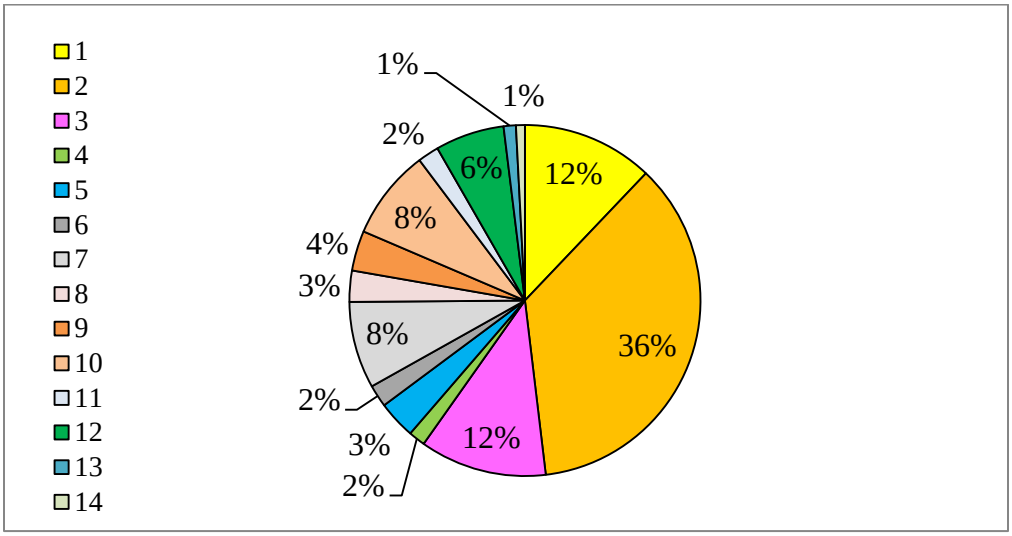

Figure 2. Group 2 Time Spent Breakdown

1 - Teachers' math understanding and knowledge
2 - Instructional skills and strategies
3 - Students' thinking and understanding
4 - Insight and positive comments on the lesson study process
5 - Critique on / resistance to / difficulty with the lesson study process

6 - Teacher as researcher

7 - Student previous knowledge

8 - Terminology / Language

9 - Anticipated student response

10 - Expectations for student learning and achievement

11 - Challenges of the educational system

12 - Coach guidance

13 - Assessment

14 - Connecting to real-life experiences

Teachers' Own Mathematical knowledge

The teachers' own understanding and knowledge of mathematics and fractions took a large portion of the discussions throughout the lesson study cycle – about 12%.

In the first three meetings, the group was solving problems from the teacher's manual individually and then sharing with the rest of the group their solutions, offered different ways of looking at the problems, and explained their thinking, focusing a large portion of the time discussing their own math and fractions knowledge. Through this process, the teachers came to some interesting insights. As they were sharing their answers, they realized that they are not able to explain the mathematical reasons for the way they each solved the problem:

> Josh (2): The algorithm for dividing a fraction by a fraction that we're taught doesn't make any sense, it's just 'just do it' kind of a thing. Explain to me why? [1A, 4:00]
>
> Nichole (20): I can do it but I couldn't answer this question… [1A, 5:00]
>
> Sheryl (11): As a student they explained it to us, I don't remember how they did it but after they explained it I was able to remember that [1A, 5:00]

The lengthy discussion of the teachers' own knowledge about math and fractions brought to light difficulties and weaknesses that the teachers experienced, as they were trying to understand their reasoning and ways of thinking as they were solving the problems. Andrea (3), for example, who came to the teaching profession as a second career, explained that her familiarity with fractions was due to her experience in her previous job using fractions on a daily basis:

> Nichole (20): So why did you guys know what to do automatically? Do you work with fractions? Because if you don't, you tend to forget it [1A, 17:00]
>
> Josh (2): For me it wasn't until I was older that I started visualizing and seeing it as a whole. And I think estimation is a skill [1A, 18:00]
>
> Nichole (20): I don't know how to do it… I should be able to know how to do it [2, 9:00]
>
> Sheryl (11): I didn't use the algorithm to solve the problem. I'm a very visual learner so I had to draw it [2, 14:00]
>
> Josh (2): [Reading from the manual]: So the student's difficulty in understanding might be the same one I'm having right now… [3B, 8:00]

Nichole (20) got the answer wrong and the rest of the teachers got it right, although Andrea (3) admitted she was confused about the problem when she first read it. This exercise, for which the lesson study specifically makes time for, clearly contributed to some learning that has occurred in the group:

> Emma (6): I did it wrong using the algorithm. So now I know better how to solve it like a 3rd grader. I tried to solve it visually and use equivalence as a fraction [2, 13:00]
>
> Nichole (20): It's just when you talk about number line, to me it should be absolute. And when you talk about fractions, it changes [2, 37:00]
>
> Emma (6): But you're just talking about increments [2, 37:00]
>
> Nichole (20): The number of the unit is absolute. What you're using it to describe changes the number line. Which means that you are thinking in terms of a whole and not an absolute number [2, 39:00]

Josh (2): A number can be absolute but still a part of the whole [2, 39:00]

Emma (6): It's just a tool to counting stuff [2, 39:00]

Andrea (3): like decimal points [2, 39:00]

The literature suggests that novice teachers lack sufficient mathematical understanding coming out of preservice training (Cooney, 1999). However, for this group, it seemed that all of the teachers needed to refresh their mathematical knowledge, and especially the most experienced teacher. This might, however, stem from her being a 2nd grade teacher and not using this knowledge on a daily basis. Sheryl (11), the 1st grade teacher, however, got the answer right. Such a case is also described in the literature when many teachers do not have sufficient subject-area knowledge to teach students from a diverse background and match their achievements with the academic state's standards (Cross & Rigden, 2002).

As they were explaining their thinking in solving the problems, they realized they each think differently, just like their students:

Sheryl (11): I'm very visual so I drew a picture… [1A, 24:00]

Nichole (20): I added them as 3/4. Like money [1A, 25:00]

Emma (6): I was visualizing the pie also. But I was also thinking about a ruler. So the number line is also kind of handy [1A, 25:00]

Andrea (3): And I was working with fractions that fit on halves, fourths, and eighths. I used a number line in my head" [1A, 26:00]

Andrea (3): We all did it differently. Some of us were more similar but some of us were really different [8A, 40:00]

When the teachers were explaining their methods and thinking about solving the problem with the paper strips, they again saw how each of them did it a little differently, and came to close, but not similar answers. Commenting on other teachers' ways of

solving the problem, both Josh (2) and Andrea (3) said: “That’s very cool” [2, 58:00; 2, 59:00], suggesting that learning and positive insight has occurred for them.

Some of the gaps in knowledge might have stemmed from the different grade levels that the teachers taught and it seemed that they are more accustomed to what and how they each teach their own grade-level. Thus, the gaps in knowledge could have resulted in the higher or lower level of fractions the teachers were more familiar with as a result of their grade-level expertise:

> Nichole (20): I'd like someone to show me on the linear thing how to multiply… [7A, 44:00]
>
> Emma (6): You just add them up and it works really well [7A, 44:00]
>
> Nichole (20): I still never understood how when you multiply numbers in fractions, they get smaller. When you multiply something it gets larger [7A, 47:00]
>
> After Emma (6), Andrea (3), and Josh (2) are trying to explain it to her she said:
>
> Nichole (20): Yes, I know it and I get it, I just never understood it. Because when you multiply something… that's what the word multiply means. More. And somehow when you do fractions it makes them less [7A, 48:00]
>
> Sheryl (11): You're multiplying parts [7A, 48:00]

Anticipated Student Response and Student Thinking

As the group was reading the manual for anticipated student response for the problem they just solved, they realized that only one fourth of the students are able to give the correct answer and were trying to understand how the students who got it wrong reached their answer. As they were trying to answer the question presented in the manual - why do so many students find this problem difficult? – they were focusing on student thinking and anticipated student response, discussing what they wanted the learning

outcome to be, what they wanted the students to be able to do, and their students' anticipated capabilities to do so. They also paid attention to the terminology of the questions, connecting certain words to a student's possible misconceptions:

> Andrea (3): I think that's the hardest thing about fractions - is it close to being a whole or a tiny sliver of it? How do you see it? [1A, 17:00]
>
> Josh (2): I think they don't know what they're being asked and they don't know how to filter out information from the problem [2, 9:00]
>
> Josh (2): I think one of the problems is the word 'divide'. This is what I did… followed procedure. But hesitated because it's not what was taught to do [2, 11:00]

Their discussion led them back to their instruction as part of the students' learning abilities:

> Sheryl (11): They're used to us teaching them to look at the cubes and they don't really understand what we're asking them [2, 16:00]
>
> Josh (2): So we use the same language for the measurement as to describe what you're trying to figure out [2, 16:00]

When the teachers finally looked at the students' possible wrong answers in the teacher's manual, they were surprised of some of the misconceptions and took the time to try and understand the students' thinking in getting to those wrong answers. This is an indication that the lesson study process does bring into their attention new information and prepares them better to deal with students' possible misconceptions:

> Nichole (20): They got the right answers but you don't know how they're getting the right answer. It might be that their explanations doesn't make any sense and adding one more to it [the method the student used] isn't necessarily what the kid was thinking [1C, 6:00]
>
> Emma (6): Kids are thinking of fractions as what they're representing and they're only able to explain it in terms of using math… [1C, 6:00]

> Andrea (3): This is the hardest for me... They talk about fractions as numbers, I can't see them as anything other than numbers so why is it a question? What other way would they be thinking of it other than a number. Maybe this is where I don't understand student thinking... [6A, 16:00]

When the teachers finally had their lesson plan, they spent some more time considering the students' possible answers and were trying to anticipate their misconceptions:

> Sheryl (11): [Playing with the strip] I'm thinking about some of the possible answers that the kids might come up with. I'm feeling like I don't know anything about what might happen [12A, 46:00]
>
> Andrea (3): I think they're going to think it's 1-1/4 because of the 4 parts. So they're probably going to figure that out, how many time that little piece can go in there and will end up having 4 parts [12A, 46:00]
>
> Sheryl (11): So what are they going to say? [12A, 46:00]
>
> Andrea (3) is drawing it and trying to guess student thinking and anticipated responses.
>
> Sheryl (11): So they'll say it's 4/4? [12A, 47:00]
>
> Josh (2): They might say it's 4/4. They might say it's 1 plus 3 because they'll fold the meter strip to 3, and then they'll say it's 1-2-3-4. Yeah… [12A, 47:00]
>
> Andrea (3): And you know you'll have some kids that'll take the long strip and fold it in half, which doesn't make any sense with that little piece, and we'll have to redirect them 'this is the 1 meter measurement' [12A, 47:00]

Familiarizing with the Japanese Lesson Study

The next three meetings focused on the Japanese teacher's manual and the example videotapes of the Japanese teacher teaching his lesson study. They started by analyzing the problem posed to the students, touching on student thinking, instructional strategies, and anticipated student response. The teachers' reactions clearly showed that the Japanese way of instruction was very different than their own and they were trying to

make sense of it. Emma (6), for example, commented on a way of explaining something in the Japanese textbook, saying that she wouldn't have explained it that way and realizing that in the Japanese book the concept rather than the definition was explained:

> Josh (2): It's interesting that they show volume in a linear way [3A, 20:00]
>
> Sheryl (11): We need to change their mind set so that when they see a fraction, they don't just see it as a part of a number. And that they could use a number line and find the exact spot of the fraction [6A, 17:00]
>
> Josh (2): Another thing is that you can divide 1 whole into 1/5s... They'll need to do it in later grades but they're confused because we don't do it in a way that is concrete, we just go straight to the algorithm [6A, 18:00]

The teachers were also making positive comments on the Japanese instructional strategies, indicating learning and insight:

> Josh (2): Look at [a problem in the Japanese textbook]. I kind of LIKE that they do it this way. [reading from the textbook how they are asking for the denominator first and then for the numerator]. Wouldn't you normally do the numerator first and then the denominator? Because we do things from top to bottom… [3A, 17:00]
>
> Josh (2): I think that also being very very concrete… Saying they teach one at a time to proficiency [3B, 21:00]
>
> Emma (6): Right and don't say 'see, it's backwards. The fractions get smaller as the number gets bigger. They should not be thinking that the numbers are going in the reverse order but just understanding that the more pieces that you divide it to, and that's why the pieces are smaller. People are teaching it incorrectly, I guess [3B, 21:00]

Instructional Strategies

As they were discussing how the students may solve the problems, they were offering the instructional strategies they used, which were different for each grade level:

> Nichole (20): I just have to say that I'm only a 2nd grade teacher and these fractions are on a very basic level. I get it. But when it goes to the parts of the

> whole I think most kids at this level would do a whole and then cut it up in pieces than visualize this as a set... [1B, 00:00]
>
> Josh (2): I have to say that the fraction bars do help out a lot. Because as opposed to a circle that you have to divide into slivers, when it's a fraction bar, you can see right there that one is the exact same length as the other. And it's so much easier for them than the circular ones [1B, 1:00]
>
> Sheryl (11): We use chocolate bars… [1B, 2:00]
>
> Emma (6): But the cool thing about the pie is that you can see… with the bar you don't… It's hard to visualize how far it's really going and with a pie you always know how close you are to a whole circle [1B, 2:00]
>
> Andrea (3): See, 4th grade is different because number lines are everything [2, 29:00]

Throughout the lesson study process, the teachers were going over many examples of instructional strategies in the Japanese textbook and the teacher's manual as well as sharing their own. For example, Andrea (3) shared a technique she uses to facilitate students' understanding of fractions in a concrete way which none of the other teachers was familiar with and which they all loved [3B, 3:00]. In fact, for this group, discussing instructional strategies took the bulk of their meeting time and comprised of 36% of their discussion time throughout the lesson study cycle (Appendix C):

> Josh (2): The other thing we have to do is task or experience [Reads the example]. So they have to be in situations where they communicate it that way or that you help them communicate it that way [3B, 2:00]
>
> Sheryl (11): This liter example too [3B, 3:00]
>
> Andrea (3): Yeah, and then a slice of bread, you cut it into 8 slices, and then a slice of bread is its own thing, right? But then you can show how it's a part of the loaf of bread too. But it can stand on its own [3B, 3:00]
>
> Nichole (20): I don't know, I'm thinking in terms of a whole and not linear, and like I said, if you have something, I think it's reasonable to ask a kid: 'take this and cut it into 3 equal pieces'. Or 4, or 6… and start seeing the relationship of… that it gets smaller if they visually see that the pieces are getting smaller [3B, 16:00]

> Sheryl (11): If we just tell them off the bat that this is a meter but there's an extra piece. So it would be a meter and what else? And they would just focus on that little piece. Maybe that can help them clear up that… [8A, 26:00]

The teachers also raised some concerns about some of the instructional strategies, and were not confident of the students' ability to understand and follow them:

> Josh (2): I can see they're not getting it… throughout the whole lesson. Because, again, the way that they see fractions as part of a whole, it makes fractions kind of difficult for them, or fractions greater than 1 [8A, 25:00]
>
> Andrea (3): But they're really just looking at that piece. So it becomes its own little fraction. Will they be able to separate it out like that? [8A, 25:00]
>
> Josh (2): But aren't they looking, don't they have a meter strip too? So they're comparing it against the unit? So I think if we gave them 1 and 1/5, without introducing them to the smaller unit, that they would have a hard time… I just think it would be very difficult... [8A, 25:00]

Emma (6) even took the role of researcher when she countered the other teachers concerns suggesting they should be ready to help the students but not in a hurry to do so since "they could come up with some interesting ideas" [8A, 26:00].

Perhaps the plethora of available possible directions was actually what was making it so hard for the teachers to choose one course of action for their lesson study. They had a hard time focusing and choosing one direction to go in with their students for the lesson study.

The Japanese Teacher's Manual

As the group was choosing a topic to teach and goals for the students and for the lesson, the teachers went over the teacher's manual and the suggestions for the prescribed

path that they wanted to teach. Similarly to group 1, this group was also intimidated and discouraged by the size of the teacher's manual:

> Sheryl (11): Look at this [flipping through the teacher's manual]. Look how many pages this is. Are we reading this too? We need to go over all of it… [7A, 19:00]
>
> Andrea (3): Oh my gosh, it's huge… [7A, 19:00]

Even when the teachers decided that they will individually look at the teacher's manual at home, they came back the next meeting and none of them read it, some because they did not have the time to, and some because they couldn't focus after hours. There is something to be said about the demands from teachers to work after hours. They are expected to plan their lessons and grade exams, and unless a block of time dedicated to a specific task is built into their work day and properly compensated, it is difficult for them to dedicate their own time to more work. At the same time, if the lesson study process was an ongoing process in the school, the teachers would slowly get familiarize with the manual and would not need to spend so much time on understanding the process and reading instructions and explanations. Turning the lesson study to a long-term process guided by experienced coaches could eliminate some of the problems that arose in a one-time experiment that the teachers knew will end after one lesson.

Teaching as a Cultural Activity

As the teachers were thinking of how to teach fractions to their students, they were remembering the way math was taught to them. Since teaching is such an innate invisible cultural activity (Hiebert & Stigler, 2000), the teachers had a hard time separating their own experience learning mathematics and coming up with new hands-on

ways of teaching their students, even when they agreed they should. Nichole (20) even claimed that the way they were taught is the right way but because of new demands of the department of education, they need to teach in a different way:

> Sheryl (11): I'm thinking back to when I learned how to do this, and they just straight tell you - you have to find a common denominator… [3B, 17:00]
>
> Emma (6): Yeah, we never did anything with manipulatives or any visuals… [3B, 17:00]
>
> Sheryl (11): Yeah, they just tell you the rules and that's it. And then you just practice [3B, 18:00]
>
> Nichole (20): And that's fine and I'm a big believer in doing that but that's not what you're supposed to do in education in America... Because everybody's supposed to go to college and everybody has to compete with these countries… [3B, 18:00]

Furthermore, even teachers that were working somewhat similarly to the Japanese way, did not make the leap and trust the students to follow this new way of instruction:

> Andrea (3): It will be their first introduction to fractions so hopefully that'll kind of push them through if it seems like unknown territory. In 4th grade we actually have to start the whole lesson with an unknown question. And they actually think about it in different ways, sometimes if I give them enough room, they actually do things in different ways [12A, 40:00]

In addition, and much like group 1, the group also had trouble using a prescribed lesson plan, pointing to the individuality that is characterizing the American teaching profession (Stigler et al., 1996; Hiebert & Stigler, 2000):

> Josh (2): I feel lack of originality, I just teach it the way he [the Japanese teacher] taught it. So I'm wondering, do we want to brainstorm on a different way to teach the lesson? [6A, 12:00]
>
> Josh (2): With this sequence teaching and evaluation plan, we don't do anything… let's take the next 7 weeks off… we got the book, we got the plan… [7A, 53:00]

Finally, and again, similarly to group 1, the group discussed arranging the students into pre-determined teams before conducting the lesson study. This is in accordance to the literature that talks about the commonality of this practice in the U.S. (Stevenson, 1998):

> Nichole (20): If it was my class there are 1 or 2 that would, you'd need to have the support as far as their curriculum. Are you going to decide the groups ahead of time? [10A, 55:00]
>
> Emma (6): Yeah [10A, 55:00]

Terminology and Student Thinking

As the teachers were going over the prescribed lesson, they paid attention to the terminology used in relations to student thinking and came to the conclusion that equipping the students with a larger vocabulary describing the same thing, as the Japanese do, could better prepare them for the tests:

> Josh (2): [Reads from the textbook:] It's 'bigger'… [7A, 31:00]
>
> Andrea (3): What's wrong with thinking bigger? [7A, 31:00]
>
> Josh (2): Because it gives you the child impression that there's size… or… it's not the proper terminology… greater and less [7A, 31:00]
>
> Nichole (20): I think it's very good because it seems to be all about testing and you never know what language they're going to use [7A, 32:00]
>
> Andrea (3): That's true. It's really true [7A, 32:00]
>
> Nichole (20): Sometimes the kid actually knows it, they just don't know the language that's being used. And 5, 6, 7 year olds using academic language all the time… Makes them feel like they don't understand what we're talking about… But it doesn't mean that they can't do exactly what we're asking [7A, 32:00]

Guidance

At the group was trying to plan their lesson, the teachers started to get lost in the process. It was very difficult for them to make decisions and go forward. Instead, they were going back and forth to the same points and were very confused about what they were actually supposed to do:

> Nichole (20): I'm not sure what we're doing, I don't understand… What am I looking for? [7A, 21:00]
>
> Nichole (20): I don't understand what we're doing… Are we not going with this one? [8A, 20:00]
>
> Josh (2): I don't know what we're doing either… [8A, 20:00]
>
> Nichole (20): [To Bonnie]: What is actually the research question then? […] Give me an example of a research question [8A, 41:00]
>
> Andrea (3): We are so wishi-washy… [8A, 48:00]
>
> Nichole (20): I don't get it. What is our point then? [8A, 51:00]
>
> Nichole (20): It seems like we're doing a lot of talking just to come back and do this [pointing to the teacher's guide]. So we're doing what he did? Same lesson? [8A, 53:00]
>
> Emma (6): We decided and then we kind of took two steps backwards… [9A, 2:00]

After attempting to choose their topic and goals for their lesson study, the teachers felt as they were not progressing and were having problems deciding on a course of action, and requested Bonnie to join them in their next meeting to guide them through the process:

> Andrea (3) [to Bonnie]: Last week we had a difficult difficult meeting where we couldn't get our focus about… the transition… we're doing what they're telling us and all of a sudden it's on us [8A, 00:00]
>
> Josh (2) [to Bonnie]: I think at first, weren't we having a hard time kind of straying away from the lesson he gave? [8A, 6:00]

Bonnie offered guidance regarding the process but refrained from making suggestions regarding the group's lesson study. Her guidance was so needed, that even though she only participated in two meetings overall, her guidance took up 6% of the total meetings time:

> So you have some big ideas that you want, you just have to see how to make it into the lesson [8A, 00:00]
>
> Well, a research question might be: can students find the whole if they have a part? Do students understand how to partition? Do students understand a unit? Do they understand that the smaller the denominator the bigger the fractional piece? Any of those can be... [8A, 41:00]
>
> And you can certainly put a touch up on these things. If you like one more than another you can wrap it up in a different way or… [8A, 57:00]
>
> I think it might be useful if you went back and looked at that first video, it's just a short clip of it, but you get an idea of what happens through the lesson [8B, 2:00]
>
> I think the trick is thinking about what fractions you want to show, how long it's going to take to… that's why I think it would be really good for you to figure out what materials you want, actually do it with each other to see how long it takes you guys to do it [8B, 3:00]

It was very apparent that the meeting Bonnie was present in was going much more smoothly and progressing with less doubling back and circling around a certain topic. It seemed that when the group had a leader which they perceived as knowledgeable and as an authority figure, they were more willing to accept certain points of discussion and able to move the process forward better.

With Bonnie's guidance, the teachers were able to conduct a more productive and meaningful discussion about what they want their lesson study to be:

> Nichole (20): Well, I think we all… well, some of us like different things, but I think we're kind of referring to the 3rd grade teachers, what's appropriate for the 3rd grade? What's the most beneficial? [8A, 42:00]

> Andrea (3): Last year, my 4th grader had trouble understanding a whole unit. They think they know it but they don't know it. The whole idea of 1 as a whole was hard [8A, 42:00]
>
> Nichole (20): So would you think that's an issue of knowing what the whole is or the meaning of the denominator? [8A, 43:00]
>
> Andrea (3): That's a hard one too and then comparing them. But if you give them a number line, like some of the test questions last year what would just throw them was when it had a mark, one of the fractions had a mark and they were supposed to say what that number was. And they were given choices and that was hard for them. So I think these are really appropriate if 4th graders are having trouble with it then 3rd graders... [8A, 43:00]
>
> Nichole (20): So then the partition of the fractions is something that would be very beneficial, ha? [Reading from the teacher's guide] The number line… They make it easy to see that the same point can be described by different fractions [8A, 44:00]
>
> Nichole (20): So anything we decide to do, we need to put in that context [9A, 00:00]

However, even then the group had a hard time progressing until Sheryl (11) took it upon herself to put down in writing what the group has talked about thus far. This way, she encouraged them start working from a written draft to promote the progress of the lesson study cycle [10A, 41:00]. Sheryl (11) also typed up their decisions for the following meeting prior to it on her own [11, 00:00] and Josh (2) and Emma (6) met together as well to create the lesson study from the group's notes for the meeting after that [12A, 3:00]. This highlights the difficulty this group had in making productive progress during the actual meetings and cooperating amongst themselves.

Teaching the Lesson

When it was finally time to choose who will teach the class, it seemed that none of the teachers wanted to do it:

Nichole (20): Why don't we vote? [11, 5:00]

Josh (2): No, no no… that's not how it works… [11, 5:00]

Nichole (20): Maybe somebody wants to do it… [11, 6:00]

Josh (2): You can do it… [11, 6:00]

Josh (2): I think we should pull sticks. Andrea agrees. [12B, 1:00]

Nichole (20): I just don't feel that being a 2nd grade teacher that I get it… I mean I get it, but it's so foreign to everything that I want to do… [12B, 2:00]

Josh (2) talks about how Sheryl (11) did a really good job teaching a previously taught lesson study and how it's not about how well the lesson was taught but how well it was designed. Sheryl (11) replies that she wants to observe this time because she didn't get to do it last time.

Josh (2): And if you [Nichole] are really adverse to doing it, then we can respect that [12B, 3:00]

At this point, the teachers had one more meeting before the actual lesson but they still did not have a lesson plan written down and specific a goal that they have decided upon [11, 18:00]. Before the next meeting, which was the last one before teaching the lesson study, Josh (2) and Emma (6) met separately on their own time to put together the group's notes and created a draft of the lesson plan. The reason they met was possibly because they were both the 3rd grade teachers and it was Emma's class that was going to be taught the lesson study, and Josh was the one chosen to teach the lesson study. In any case, ideally, this should have been achieved during the meeting with the participation of all the teachers.

Even though the teachers were talking about pulling sticks to choose the one teacher who will teach the lesson [12B, 0:00], the actual decision of choosing Josh (2) and the way it came to be was not in the videos.

Assessment

In contrast to group 1, this group brought up the question of assessment for success or failure of the students in the lesson study. As with other elements of the lesson study, there appeared to be some confusion about determining how successful or unsuccessful the lesson study was:

> Andrea (3): …And then, if they don't solve it, it's ok. It's not about them solving the whole problem, but more of exploring the whole concept [11, 29:00]
>
> Nichole (20): So then our goal is… so how would you identify if they explore it well? I thought we were supposed to set some specific goals… [11, 30:00]
>
> Sheryl (11): They'll have to do a post-test too so we'll be able to see how much they've learned [11, 30:00]
>
> Nichole (20): Well then, if there is a test, what would the results be? [11, 30:00]
>
> Emma (6): Well, then we have our observations to know if this was a useful way to be teaching it, and we'll have our observations about what not to do and what was difficult for them, if it's too easy […] [11, 30:00]

At this point, as the teachers kept talking about this for a few more minutes, it seemed like they were not on the same page about what piece or unit they are going to ask the kids to measure, what pieces of strips they will give out, etc. The teachers had one more meeting before actually teaching the lesson study and still, it felt as though they keep repeating the same points and going around in circles. This meeting ended a few minutes later with no conclusion regarding the standards of the success or failure of the lesson study.

Debriefing after Teaching the Lesson Study

In the debriefing, after the lesson study, the teachers were bringing up positive and negative things from the lesson; things that they thought worked and things that they thought did not work; difficulties; points to improve; and insight about teaching. At one point, the teachers were discussing together how they could have directed the students better [14, 21:00]. In addition, group process and collegial experience, although indirectly, were brought up for the first time during this meeting:

> Nichole (20): Some kids didn't even make the tally. And you [Josh] didn't either. You used your finger. So they were coming up with the wrong answer and I think that's really a measuring technique, strategy. And the language felt off. I feel that language would make the connections. I found it extremely interesting [14, 10:00]
>
> Nichole (20): The students that were actually writing on it [the paper strip] were closer [14, 25:00]
>
> Nichole (20): Kids in the back didn't hear the kids in the front… you lose your audience… [14, 39:00]

For this group, perhaps this was the beginning of the meaningful learning and the first time they understood what to expect of the lesson study process in order to do it better next time. If they were to continue the process, whether it is to teach the same lesson again to a different class with adjustments, or choose a new topic and create a new lesson study, perhaps after going through it once they would have known better what to expect and would have been more happy with their results, or at least more efficient in the process.

This meeting allowed for the most insight into the teachers' thinking about and learning from the process they went through. In combination with the written reflections and the videotapes, each teacher's journey through the process was analyzed:

Nichole – 20 years of teaching experience. In her written reflection, Nichole focused on student thinking and misconceptions and realized how crucial they are for student learning and the success of a lesson, mentioning that without the lesson study, where she could focus completely on the students, she might have not come to this realization:

> First and foremost, that it was a blast observing the students as they listened and participated in the lesson. I realized I knew exactly what the instructor was doing and why, that I could focus entirely on the students. It allowed me to see the lesson more from the students' point of view and see how omitting something, lack of a unrelated skill, misunderstanding a term, etc. can impact the results [written reflection].

She also wrote that even though she does not believe she will have sufficient time to do so, she would like to put more emphasis and give more attention to the students' misconception by anticipating their responses beforehand and prepare an explanation in advance in order to correct them in class and facilitate better understanding and learning:

> Anticipating what/where lesson might go (outcomes) and planning a response for that. I don't know if I'll ever have this much time to work to kind of detail but I think I'll attempt to look at my grades big concept like this and see if I can head off misconceptions or mistake beforehand [written reflection].

Even early on in the meeting cycle, Nichole was paying attention to the student thinking:

> They got the right answers but you don't know how they're getting the right answer. It might be that their explanations doesn't make any sense and adding one more to it [the method the student used] isn't necessarily what the kid was thinking [1C, 6:00]
>
> And kids, sometimes, if it's longer than 1, they just want to go to 2. And having the 2 up there can show them that it's more than 1 but less than 2 [4B, 3:00]

Accordingly, in the debriefing, Nichole brought up her conclusion regarding the students' misconceptions about fractions:

> It seems to me that what kids thought of as a fraction was a number. And they were just trying to get to a number that wasn't necessarily relating to anything else [14, 7:00]
>
> Somehow it seems that if they had more experience with the language and experience with the measurements, that the two would come together. Because we assume that if you learn fractions, you can measure. But some of them did not know how to measure. Measuring is a skill. And we assume kids know how to do that... [14, 9:00]

She also came to the conclusion that a lot of the students' difficulty results in lack of knowledge or skill that is teachable and should be addressed before teaching the mathematical concept:

> Group dynamics sometimes interfere with somebody's style. That's also something you teach… [14, 17:00]

At times throughout the process, Nichole assumed the teacher as researcher role:

> Sometimes one kid came up with an answer that it spread and everyone were giving the same answer. They didn't really know enough about what the number meant to defend their answer. It would be interesting to do the same thing with numbers where they would be more willing to defend or disagree [14, 18:00]
>
> It is interesting to teach them what exists between 0 to 1 [8A, 33:00]
>
> "They seem to feel that using a linear method help students develop important insight about fractions. And they keep emphasizing this 6 time on this page… it doesn't matter what we decide to teach we just need to put it in a linear context [9A, 3:00]
>
> It's made me want to go back and do more of… play a little more with some of the math… [12A, 40:00]

Nichole gave a great deal of attention to the students' previous knowledge. She repeatedly asked the other teachers what and how they are teaching in their grade level, and consistently warned them of how little previous knowledge 3rd graders have when they come out of the 2nd grade – her grade level:

> Are we doing 3rd grade? Do we need to introduce them to linear concepts or is that something they already know? Because that's not something they're coming out of in 2nd [7A, 23:00]
>
> We don't do linear coming out of the 2nd grade, we haven't done linear at all, that kind of solves that we need to do an introduction. Don't you agree? [7A, 24:00]
>
> Because a lot of my kids would be stuck on trying to learn to identify what's 1-1/3, 1-1/4 means… [11, 29:00]
>
> I think that in order to get through the lesson we need to introduce the linear concept beforehand. And I don't know what you do with your kids, I don't do anything linear following the book in 2nd grade, it's all pictures [11, 35:00]

Watching the videos, it seemed that it was important for Nichole that the lesson would be meaningful and beneficial to the students and perhaps her dissatisfaction resulted especially when she didn't feel that the process is in fact reaching those goals:

> We liked stuff but if we were going to do it in 3rd grade, it should be one that benefits the 3rd grade [8A, 36:00]
>
> Well, I think we all… well, some of us like different things, but I think we're kind of referring to the 3rd grade teachers, what's appropriate for the 3rd grade? What's the most beneficial? [8A,42:00]
>
> So would you think that's an issue of knowing what the whole is or the meaning of the denominator? [8A, 43:00]
>
> So then the partition of the fractions is something that would be very beneficial, ha? [Reading from the teacher's guide]. The number line… they make it easy to see that the same point can be described by different fractions [8A, 44:00]

In addition, and maybe because she truly wanted the process to be meaningful, in the back of her mind she was always taking into account the tests that the students would have to pass eventually:

> We need to change this so that it fits our measurement unit [inches]. We're teaching to the test so… [6A, 56:00]

Watching the videos, it felt that she had a different language than her colleagues and had a lot of trouble expressing herself clearly in a way they would understand and get on board and sometimes it was hard to infer her point from a long monologue:

> I like math, I can do math - if I saw an example I can duplicate it. But I have to say being a teacher teaching the same thing over and over every year, every time it's like: "ah! Now I get it" and it's imprinted in my brain, just teach it and go on to the next unit and go back to it next year.. And I don't know how you'd do it... especially estimate, we do estimate for a day or two and then we move on. In 2nd grade, I don't know about you guys... [14, 20:00]
>
> Can we do all this with fractions? We do all this and it seems like in the Japanese thing they want to make a real big sense on the linear thing and you realize, once they get to reducing them, it's just about adding, subtracting and multiplying, they don't want you to know that beyond... [7A, 44:00]

Another example for Nichole's communication difficulty was when she questioned the journal writing [9A, 36:00] but the group insisted and she decided to drop it and conform. However, a few meetings later, when the topic of the students writing a journal came up again, Sheryl (11) said: "This is our chance to give them more time than usual, time to do math", and Andrea (3) replied: "Yeah, that'd be great! I like that. You mean for one idea, just exploring it. Yeah, I like that idea" [11, 23:00]. She also questioned the amount of elements that can be incorporated to a one 40-minutes lesson [11, 23:00]. It seemed that, coming from someone else other than Nichole (20), ideas

were accepted more easily. As a result of that, a few good questions that Nichole (20) raised and could have been discussed got lost:

> Why are fractions so much harder to think about than whole numbers? Instead of a one level of operation, it turns it to 2-3 steps problems [6A, 20:00]
>
> But there's still so much that the kids who can't do are not learning anything, just… copying… it just seems like it takes them away from the math and ends up being language arts lesson [9A, 39:00]
>
> Because I think in the video, one of the reasons he was so successful was because the kids were thinking about math and being able to articulate about math, it wasn't like, ok, now go write about it [9A, 39:00]

It seemed that the pace or organization of the group was not right for Nichole who felt that they should have decided a few things before continuing to other things. For example, she wanted to decide what grade level will be taught before thinking of the instructional strategies:

> Depending on what grade we decide to present it to, we should decide on something that's level appropriate [6A, 13:00]
>
> I think we should focus on the lesson instead of talking about who should be in the room… [11, 14:00]
>
> Our time will run out and we haven't done the lesson… [11, 14:00]

When the teachers were solving the math problems, Nichole was the only teacher that got the answer wrong [2, 9:00]. A possible explanation of Nichole's dissatisfaction with the process might be that she felt she does not have enough knowledge and experience with the grade in which they taught the lesson study – the 3rd grade:

> I just have to say that I'm only a 2nd grade teacher and these fractions are on a very basic level. I get it. But when it goes to the parts of the whole I think most kids at this level would do a whole and then cut it up in pieces than visualize this as a set... [1B, 0:00]

> Again, you're taking something and breaking it up to pieces again thinking of it as a whole and not as numbers. Should I be thinking about it as a number on a number line or as a candy bar and I have half of it? [2, 32:00]

In one of the last meetings, Nichole offered an explanation for her difficulty in the process:

> Do you know what I figured out why this is difficult for me? Because in our levels, the lower grades, we show them, we teach them, and then they do it. We're not teaching them first. They're kind of tapping what knowledge they have and see if they can figure it out... and that's what's taken me a while to get my head around. I don't usually do that in the 2nd grade. You usually have to show it, teach it, then they go practice it. And they've never actually done this before [12A, 38:00]

Throughout the videotapes, Nichole appeared to be unsatisfied of the process and had a lot of criticism towards the process and disagreement with her colleagues. She exhibited confusion that was evident all through the lesson study cycle:

> I don't know how to do this without ever having read it or done it before… [2, 0:00]
>
> I can't believe that the manual recommends just giving them the whole, giving the measurements rather than trying to understand what you're actually measuring" [4B, 8:00]
>
> Well, how are we going to choose one if we don't take a look at the Japanese […] [7A, 19:00]
>
> I'm not sure what we're doing, I don't understand… What am I looking for? [7A, 21:00]
>
> We already decided not to go there so do you really want to revisit it? [7A, 39:00]
>
> I don't understand what we're doing… Are we not going with this one? [8A, 20:00]
>
> Introductory meaning what he did or what this book is saying? [8A, 51:00]
>
> I don't get it. What is our point then? [8A, 51:00]
>
> It seems like we're doing a lot of talking just to come back and do this [pointing to the teacher's guide]. So we're doing what he did? Same lesson? [8A, 53:00]

> They [the Japanese] spend four 40 minutes lessons on just the size of the fractions. But we're going to take this whole thing and do it in 45 minutes? [8B, 0:00]
>
> [Teasing]: Just know that if I'm teaching your kids, I'm telling them that I didn't pick the lesson… [laughing] [9A, 41:00]

Despite her criticism of some of the aspects of the process and the Japanese way of instruction, Nichole did seem to have some positive remarks and insight through the process and some new learning has in fact occurred for her:

> You and I [Sheryl] teach that fractions are a part of a piece… No wonder kids don't make the leap… They're not thinking literally like a number line. It says that's exactly how we are not supposed to talk about that… [2, 40:00]
>
> You know, this is interesting because this [in the textbook] is instructing the whole and giving the parts and we take the whole and cut it up into parts, I mean, this is going the other direction. We do that with other stuff… [3B, 27:00]
>
> In response to the leading question in the teacher's guide - What elements of instruction might help students build a strong mental image of the connection between the units and the whole? – she said: Just like they did. Hands-on. They're actually accounting for it [4B, 6:00]
>
> [Flipping through the textbook]: Cool pictures! Better than ours [7A, 45:00]
>
> The say although we have a lot of resources in the US, they're targeting this, that they feel this is somewhat neglected. And that the main thing is linear measurement content. See I'm starting to get into this! [9A,0:00]

Sheryl – 11 years of teaching experience. In general, Sheryl was very quiet and was not very talkative during the lesson study cycle, relative to her colleagues. However, she was very invested in its success and did not appear to have a problem saying something when she wanted to. Sheryl had some experience with lesson study before and she seemed to try to get her colleagues into the 'teacher as researcher' mindset. All through the process, she was following the teacher's manual instructions vigilantly and concentrating on the lesson study's goals:

> Emma (6): [Jokingly]: Let's teach them multiplying fraction! [7A, 44:00]
>
> Andrea (3): No, no… that's not even until 5th grade [7A, 44:00]
>
> Sheryl (11): Well, we could if it's at their level [7A, 44:00]
>
> Sheryl (11): I think… didn't we say we want them to do […] the activity? And I was thinking maybe we can figure out which one of these goals […] [11, 18:00]
>
> Sheryl (11): I'd actually want, if the students don't understand that they kind of seek to understand why… [9A, 26:00]

In her written reflection, Sheryl expressed a great deal of difficulty in regards to the group process and the collegial experience. She pointed out the lack of leadership and guidance in the group and the exhaustion of working in late hours of day in which the group met. She also pointed out to the need for socialization, indicated by the literature (Wong, 2004; Stigler, Fernandez, & Yoshida, 1996), as an obstacle for productive meeting. Even though she found it obstructive, it still indicates that the lesson study might fill that need of socialization for teachers. However, even the negative experiences led her to some insight regarding her students:

> I learned from this lesson study cycle how complicated collaborating with colleagues can be. We had a group that consisted of easy going, friendly, respectful and caring individuals. However, I felt anxious and at a loss for ideas at times. It's times like these that make you realize how difficult it might be for students when working in groups. The time of the day when they come together as well as the types of setting needed to optimize learning and thinking is important too. Our group struggled at times because it felt like no one wanted to take charge and lead us in the direction we needed to go, coupled with our need to socialize and overcome the exhaustion we felt from dealing with the students, this prevented us at times from accomplishing our goals. If I had to do this again, I'd prefer not to meet on a Monday after school" [written reflection].

In addition, Sheryl mentioned how she could not focus in reading the teacher's guide after hours [8A, 0:00]. This points to the problem of the demands of such a process,

suggesting that to facilitate it, the teachers need to be allotted sufficient time and resources so that they can be alert and motivated to work on the lesson study.

In her reflection, Sheryl came to the conclusion that, just like each student needs to have a role in order to facilitate optimal learning, the teachers also need a structure in order for the process to be successful:

> When Emma came up with the idea to give each student a task to complete within the group it was essentially a requirement given to ensure the students had a structure with which they could fall upon to support their learning. With adults however, who have more know how there was some resistance to the structure set up. Yet it was necessary" [written reflection].

However, perhaps the most important role – a coach or guide – was not assigned and it is possible that the resistance that she described would have had resolved itself if the group had continuous guidance through the process.

Throughout the lesson study cycle, Sheryl repeatedly pointed out two things. First, she believed that without understanding of the concept taught, the students will not be able to remember the procedure, and second, the power of visualization in learning fractions, perhaps because of her own need of visualization to facilitate understanding, or perhaps because this was more appropriate to her grade level – 1st grade:

> As a student they explained it to us, I don't remember how they did it but after they explained it I was able to remember that [1A, 5:00]
>
> They have to be able to visualize it [1A, 16:00]
>
> I didn't use the algorithm to solve the problem. I'm a very visual learner so I had to draw it and some of the kids might do it too [2, 14:00]
>
> I had them put squares together and have them color the fractions then match what is equal - trying to visually see by looking at them what is equal of what [2, 28:00]

> When I was learning math growing up, as long as I couldn't understand the reason behind something, I couldn't remember it. I would struggle with memorizing... well, I wouldn't say memorizing but as soon as you understand why this is the correct way to get to the answer, it's so much easier for you... [9A, 26:00]

In addition, throughout the process she was focused on instructional strategies, the Japanese way of instruction, and student thinking:

> They're [the students] used to us teaching them to look at the cubes and they don't really understand what we're asking them [2, 16:00]
>
> So even if we do a number line, we have to make sure it's a whole" [2, 34:00].
>
> I think that's why it's so hard for the kids to get [2, 40:00]
>
> I just think that when they give you the numbers and all that information, you're thrown off, you're not thinking about the whole anymore. I think there are different parts to it and each part is specific [3A, 9:00]
>
> But do they [the Japanese students] also have a notebook? On the side? They write down notes? I think they do [3A, 19:00]
>
> What if we pose a few questions and that would be our lesson? Let them figure it out [6A, 58:00]
>
> Do we want to start by showing them a strip that is not exactly a meter that can be divided equally to halves or thirds to get them thinking that this little strip here is what part of the meter strip? And then we'll have them do one that is over a meter long and they have to struggle to figure out that it's the meter plus this part [8A, 22:00]

At times throughout the lesson study cycle, Sheryl took on the role of peace maker and leader of the group. Although she was very humble and soft-spoken about it, she was trying to steer the group back on track when it seemed like they were going off topic. She also started every meeting by going over the rules and assigning roles to the teachers, reading from the teacher's manual out load, following the guidance question through the process, and reviewing the previous meeting's discussion. Later in the

process, when she saw no progress was being achieved, she took it upon herself to put down in writing the groups notes in her own time:

> Ok, I'll do it. I don't necessarily know what going on either… [2, 1:00]
>
> I think it would work better if we all just discussed it instead of… [3B, 7:00]
>
> Can we briefly talk about, when we finally have a lesson drafted, how much time it's going to take because we still have to do a post-test for the teachers, a post-test to the students, debriefing if we're going to do it immediately after the lesson… [7A, 0:00]
>
> So we should use the arm spend? Is that what I'm hearing? [8A, 48:00]
>
> Nichole, it sounds like you want to do something different [8A, 53:00]
>
> We kind of discussed some of these things… but I'm thinking back to when we did lesson study a few years ago and we had our arching goal that we started with [to Emma]? So do we want to go back and do that first? [9A, 1:00]
>
> [Referring to Nichole's question:] I think she's trying to ask, is there a way we want to scaffold the lesson so that it'll drive them towards that direction maybe? [10A, 60:00]
>
> I think the main focus for today is to write down the lesson [11, 5:00]

Sheryl also expressed the learning she felt had occurred for her during the lesson study itself. In her written reflection she talked about how it was hard for her to anticipate student response and plan ahead instructional strategies to advance their understanding during the lesson. After observing the lesson study, she felt as she might be able to better handle it in the future:

> The other thing I learned was from observing the students on the day of the lesson. I kept thinking if the students are struggling with coming up with an answer to the problem how much further than a meter is the little strip, how would I direct them? When we were in a group and the days before I couldn't imagine what specifically could be done. Now I really have a better sense of it [written reflection].

This also shows that some of the real learning for this group did in fact start only at the end of the process. The way Sheryl interpreted that was that the students lacked experience with such an activity and concepts:

> The children were not able to figure out the answer with just a fourth meter strip to help them along, which meant they hadn't had enough experience to help them visualize or conceive that if you measured 1/4 off 4 times, you'd have cut up the pieces exactly. They were not used to manipulating pieces of paper, even fearing the act of cutting the strip because they didn't want to make a mistake and lose the opportunity of finding the correct answer, having the strips side by side to aid in their visualization of the fractional pieces [written reflection].

Accordingly, in the debriefing after the lesson study, Sheryl was talking about the students' group dynamics and their difficulty manipulating the paper strip:

> Even if you tell them they can cut the paper strips, they are afraid to [14, 23:00]

At times, Sheryl also assumed the 'teacher as researcher' role:

> Depends what we want to see, right? If we want to see whether the kids at [school's name] can do this [8A, 8:00]
>
> But I don't even know if that's going to meet any of our goals… [8A, 23:00]
>
> I feel like it's good to do some kind of review, unless we're going to do a pilot during the lesson [8A, 24:00]

Emma – 6 years of teaching experience. In her written reflection, Emma expressed a great deal of satisfaction from the collegial learning process. She found it very beneficial for sharing ideas and anticipating student thinking and misconceptions:

> I think it's extremely valuable to collaborate with other teachers and focus on a very specific question. I would really benefit from doing small "mini lessons studies" perhaps. I love sharing ideas and puzzling through student thinking [written reflection].

Accordingly, in the meeting she does show a lot of interest in the student thinking, anticipating their response, and inquiring about ways to scaffold better understanding for her students. One example of this could be seen when Emma was reading the question from the teacher's manual - what understandings and misunderstandings of fractions might this problem reveals? – Josh (2) said to her: "You said you're really excited about this question" [1B, 4:00]:

> So how do you think the kids would do that? [1A, 27:00]
>
> Kids are thinking of fractions as what they're representing and they're only able to explain it in terms of using math… [1C, 6:00]
>
> Do you think kids can come up with a reasonable estimate of fractions anyway? Like, can anyone say 'it's about 1/3'? [4B, 5:00]
>
> And they were sort of correct, they came up with something that was correctly calculated. They were comparing it to the standard that they had already. So they were right on with figuring it out [5A, 51:00]
>
> I'm not sure if students see the paper strip like a ruler and the measurements as the fractions of the ruler so they'll be thinking about whole numbers on a number line [6A, 15:00]
>
> It gives a bit of room to talk about ideas about fractions. It's pretty open ended and we can use all sorts of fraction knowledge to solve it so… [8A, 57:00]

In the debriefing Emma concluded that the students in the groups were actually forming a discussion about the problem and that sometimes the more soft-spoken students were the ones providing the key to solving the problem in their group and that perhaps with more practice, she will be able to get more students to think of ways of solving the problems:

> But within the groups, each group had at least one student who did something that we predicted which was the key to solving it but it wasn't necessarily the most outspoken person. So I think maybe with more practice or structure in the group, more kids would listen and think [14, 12:00]

> But there were a lot of actual conversations of how to solve the problem [14, 12:00]

Emma also mentioned in her reflection that her fraction knowledge has deepened following the lesson study process and her language became more precise and her attention to that is also visible in the meetings:

> I think I'm more well versed in fractions. My language is more specific [written reflection]
>
> So we all used a visual image of a whole rather than a set so that's a really important theme to look at, that the set is another way of looking at fractions and none of us did that… [1C, 0:00]
>
> [After solving problems with the group and sharing their answers]: I did it wrong using the algorithm. So now I know better how to solve it like a 3rd grader. I tried to solve it visually and use equivalence as a fracture [2, 13:00]
>
> That's awesome, actually, that's a really good way to look at the word decomposition [8A, 30:00]

In the meetings, Emma paid a lot of attention to the Japanese way of instruction, in both content and language, and her attention to these details was a good source of learning for the group. After she noticed that the Japanese textbook is explaining the concept rather than the definition, she commented on its way of explaining and said: "I wouldn't have explained it like this" [3A, 14:00]. The quality of explanation in the Japanese mathematics lesson is mentioned in the literature and is pointed to as one of the main factors of Japanese students' success in the subject (Perry, 2000):

> Josh (2): I think that also being very very concrete… Saying they teach one at a time to proficiency [3B, 21:00]
>
> Emma (6): Right and don't say 'see, it's backwards. The fractions get smaller as the number gets bigger'. They should not be thinking that the numbers are going in the reverse order but just understanding that the more pieces that you divide it

> to, and that's why the pieces are smaller. People are teaching it incorrectly, I guess [3B, 22:00]
>
> We could get them into the habit of math notebooks because they have the science notebooks. That'd be nice [7A, 35:00]

All through the process, Emma seemed very invested and even pushed to go deeper into the Japanese practice:

> I feel like I should read this on my own so that I come back more prepared [7A, 49:00]
>
> For the next meeting, I think we should all read this [7A, 54:00]
>
> What if we watched the tapes, see if they are talking about these things… [8A, 45:00]

It seemed that Emma enjoyed exploring new ideas and liked the Japanese way of instruction and she was active in the brainstorming process of instructional strategies:

> This is really nice [looking at the teacher's guide] Did you read their goals? [Reading] [9A, 30:00]
>
> We could show slides of road signs? [10A, 48:00]
>
> What about a meter jump? [10A, 49:00]
>
> So rather than accessing their prior knowledge of fractions, we're accessing the whole knowledge and extending it with fractions [10A, 51:00]
>
> We can make up strips that are the pre-determined length, maybe even mark it out, say you have your chalk line that shows 1 meter, 2 meters, and then put a mark there and say 'ok, who can jump this far?' and have strips that are the same distance you just jumped. So giving each group a strip that's the length of that jump, and they have to find how far was the jump [10A, 53:00]

In the debriefing, Emma mentioned it was hard for her as an observer to stand back and not intervene when a student needed help. However, being an observer gave her the opportunity to notice things that she would not have if she was teaching the class:

> As an observer it was hard not to intervene when it felt the students are not making any progress [14, 14:00]
>
> I also wouldn't have notice some things if I was teaching the class [14, 14:00]

In her reflection, Emma wrote that following the lesson study experience, she had made changes to her instruction, pulling away from textbook practice questions and leaning more towards understanding that results from more time and effort in fewer problems, indicating the impact that the lesson study process had on her:

> I have changed my teaching methods a bit. I am not content to have students answer workbook questions correctly. I want them to put more effort into comprehending questions and struggling to solve them [written reflection].

Andrea – 3 years of teaching experience. Throughout the process, Andrea was commenting on new idea both from the Japanese textbook and her colleagues in a very positive way, and expressed surprise and insight as the group was going through process:

> We'll figure it out together… [2, 1:00]
>
> I like that too! [3B, 23:00]
>
> Yeah, when they do the cutting to little pieces, I really like that. Then I also liked when she said 'there are 4 little lines' and he put the lines all close together: 'you mean like that?' and then they have to think… [4B, 6:00]
>
> I liked that he also showed that […] because even if some kids weren't saying it, they may have been thinking it themselves [4B, 7:00]
>
> That's good, that may actually help you with fractions [7A, 26:00]
>
> I think it's a great lesson. I think it would be fun to do... [8A, 57:00]
>
> I like that. Because they'll all remember it because it will probably be fun for them [10A, 51:00]
>
> Yeah, that'd be great! I like that. You mean for one idea, just exploring it [11, 23:00]

She also paid a lot of attention to student thinking, instructional strategies, and expectations for their learning, and tried to understand the logic behind the Japanese instruction. She was committed to the process and expressed a desire to 'do it right':

> It's important for them to understand what is the whole unit, what is the denominator. The constant of what is represented [2, 17:00]
>
> Where it's easier to see… like 2 out of 3 miles that they run. Instead of something like shirts that are already broken up, so maybe use different examples to let them think, so then 3 can be the whole amount and 2 can be another amount [3B, 2:00]
>
> I think he was showing how the number line was continuing, adding on so it can be 1 meter, 2 meters, 3 meters… Can't think of any other reason except than make them think of more than 1 [4B, 0:00]
>
> Yeah, gets them thinking about solving the problem before they actually see it otherwise they could see it and then… [4B, 3:00]
>
> I kind of want to plan to do the lesson on a day that we can all meet after school for the debriefing because then it's fresh… [7A, 1:00]
>
> I was just following this [manual]. They're suggesting to explore more. So this is some of their suggestions of what we can do so we were thinking we should read those [7A, 21:00]
>
> Well, partly we want to do a lesson, the concepts, we're used to them, but how do me make it so that we're using some of that Japanese curriculum in it? So, taking it out of our comfort zone, in a way [7A, 49:00]
>
> What do you guys think about having the students actually write on the board? Or do they demonstrate and we draw it? [12A, 29:00]
>
> If a group gets off track, what do we do? [12A, 30:00]

Through the process and based on her interaction with the other teachers and on the observation of the lesson study, Andrea became more aware of some elements of student learning that changed her point of view as a teacher, such as differences in approach to solving a problem, distractions in the classroom, and individual rhythms and abilities to focus and concentrate. This gives a great deal of merit to the observation of

another teacher teaching a lesson and validates the importance of such a process to the growth and learning of teachers:

> It was interesting to see how, as teachers, we all had different approaches to solving math problems. Some differences were large, some small. This was important for me to see because when teaching, I should expect a very large range of approaches and understand from my students, judging from our performance as knowledgeable adults [written reflection]
>
> I learned a lot watching Josh teach and watching the engagement of the class. I am more aware of the easy distractions of a student and the need to really let a student have time to focus, as they really do have individual rhythms and abilities to 'jump into' learning [written reflection]

In the debriefing, Andrea mentioned some of the students' behaviors she observed during the lesson study:

> At first they were afraid to do things and then one kid started folding and they followed [14, 3:00]
>
> Some of the kids just took the role of writing down [14, 13:00]
>
> Overall I thought the kids were really engaged [14, 39:00]
>
> They asked really good questions [14, 42:00]

As the literature indicates novice teachers' lack of sufficient mathematical knowledge (Cooney, 1999), Andrea acknowledges deepening her mathematical understanding through the process and learning from her colleagues' past experiences and being enlightened with some connections that they made that she did not see herself. This also validates the value of sharing knowledge and experiences between teachers through this process and how such a process can facilitate growth and learning for the teachers:

> I found this process exciting and informative because I learned from every member of our team. When we discussed concepts I learned from past teaching

> experiences that were shared and also by another teacher making a connection to math that I did not see [written reflection]
>
> When I look at it it's hard for me to connect the answers off the top of my head so I don't know what connections they've made [2, 15:00]
>
> I got stuck on this one… It's hard for me to figure out what's wrong with it [2, 25:00]
>
> [When the teachers discussed the importance of teaching the denominator before the numerator]: Really? I don't… I don't know if it's wrong or not but I don't do that [3A, 17:00]

In accordance with the literature that indicates that one of the components for a successful induction program is the treatment of each colleague within a learning community network, comprised of both novice and veteran teachers, as a potential valuable contributor (Wong, 2004; Smith & Ingersoll, 2004), Andrea validated that she had something to learn from each member of the team and also felt that she is contributing as well:

> This helps in my relating to colleagues and feeling I may have something to offer or to learn at any moment [written reflection]

An example of her contribution to the group's knowledge was a technique she shared with them of how to physically show the students the concept of fractions which all the teachers really liked:

> An easy way would be taking a piece of paper, folding it in half, then you open it and show it, then you can fold it again and you have fourths, then you fold it again and you have eighths… It's too bulky to do more than that but when I've done it my class, the kids just want to keep getting it smaller and smaller, then they open it up and label the different areas. It gets kind of crazy after a while but they can see how... they all relate them [3B, 9:00]

Another opportunity of deepening the teachers' understanding was when Andrea raised a discussion question regarding student thinking:

> This is the hardest for me... They talk about fractions as numbers, I can't see them as anything other than numbers so why is it a question? What other way would they be thinking of it other than a number. Maybe this is where I don't understand student thinking... [6A, 16:00]

Josh – 2 years of teaching experience. Josh was very procedure-oriented and throughout the process there appeared to be a shift in his mathematical thinking resulting from the collegial process of working in a group:

> I know I have a hard time teaching kids who have more difficulty grasping these things because I didn't have difficulty with it […]. So I think about it mathematically and not just following the steps… And I think we need to figure out a way to teach it this way [pointing at the Japanese textbook] because maybe not everybody can go in that direction [3B, 18:00]
>
> I like that aspect of math where you're doing word problems or challenging them to puzzles that aren't just algorithms or equations, like using words and applying what they know… [9A, 25:00]

Interestingly, even though throughout the process Josh seemed positive and engaged, and expressed a lot of positive feedback about the Japanese textbook and its ideas, in his written reflection he expressed frustration of the collegial experience. He does, however, go on saying that having a common goal to complete was a fun experience for him:

> First and foremost I learned that group work can be tiresome and sometimes like herding cats, but in the end it'd fun to have a common goal and complete a task together [written reflection]
>
> I love that! [3B, 9:00]
>
> That was really good. And also that they were actually physically units [4B, 6:00]
>
> [While reading to himself]: That's cool [5A, 11:00]

> If you look at the challenge on the bottom of page 51, it looks really cool [7A, 36:00]
>
> Ok, so we'll write those things down and make it happen [9A, 46:00]
>
> And looking at the sequence, it does look like you're taking them through the journey lesson. If we use this sequence or something similar to it, you are really walking the kids through, more than I remembered in the video [11, 33:00]

Perhaps because of his frustration of the group's process, Josh and Emma met together separately to come up with a draft for the lesson plan to make things more efficient during the following meeting [12A, 4:00]. Even though other explanations for this are possible, as was previously mentioned, the objective of the lesson study was for the teachers to complete this stage of the planning as a group.

Both in his written reflection and in the debriefing, Josh expressed difficulty thinking 'on the fly' on the one hand, and not straying away from the lesson plan on the other. Accordingly, the literature stresses such a difficulty for novice teachers (Tschannen-Moran & Hoy, 2001):

> No matter how much you think you've worked something out, there are always variables that you didn't consider [written reflection]
>
> You can spend all that time planning but during the actual lesson it's really easy to veer off things, make little changes and think on the fly... It happens all the time but when you spend all this time working on it with colleagues… [14, 1:00]

Josh gave a great deal of attention to instructional strategies. In addition to the ones he was familiar with, he also liked a lot of the new ideas from the other teachers and from the Japanese textbook:

> I have to say that the fraction bars do help out a lot. Because as opposed to a circle that you have to divide into slivers, when it's a fraction bar, you can see right there that one is the exact same length as the other. And it's so much easier for them than the circular ones [1B, 1:00]

> One thing to do is use chocolate bars. Kids like pizza, kids like pie… they like chocolate bars… [2, 32:00]
>
> It's interesting that they show volume in a linear way [3A, 20:00]
>
> So they have to be in situations where they communicate it that way or that you help them communicate it that way [3B, 2:00]
>
> Or you can make them… You can write fractions on the board and they would have to write equivalent fractions that aren't in the simplest form [3B, 10:00]
>
> I like the idea of the folding. Them folding things that don't have numbers on them, and figuring out what the fraction is. But not all of the class will be able to do it [6A, 58:00]
>
> Let's think about how to express fractional parts… [8A, 56:00]

Josh also focused on student thinking, anticipating student response and expectation for student learning:

> They might use the actual digit with the concept of the fraction. So 1/7 might to them seem more than one half because 7 is bigger than 2? [1C, 1:00]
>
> One more thing is that we're used to greater numbers representing greater things and with fractions sometimes you can have a very big number representing a very small thing . It's very counter intuitive [2, 17:00]
>
> I want them to use what they learned in their lives, their everyday lives. Studies…the mastery of it [9A, 14:00]
>
> For logistics we need an early finishers activity [10A, 57:00]
>
> So would that be in the explanation or to scaffold confused groups? [12A, 30:00]

In his written reflection, Josh brought up his perception of the need to be original in planning a lesson. The literature talks about how the values of being an innovator are different in the U.S. and Japan, where the U.S. expects originality from teachers and highlights the idiosyncratic nature of teaching whereas in Japan, being a good teacher is knowing how to teach the lesson, whether it is original or not (Stigler et al., 1996):

> Looking back, I wonder how influenced we were by the featured lesson – we did, in the end, almost completely copy that lesson. I've been trying to figure out how

> else we could have taught this lesson to 3rd graders, and I'm curious to see other variations of linear fraction lessons [written reflection]
>
> "[Reading the manual and the textbook:] Dang, with this sequence teaching and evaluation plan, we don't do anything… let's take the next 7 weeks off… we got the book, we got the plan… [7A, 53:00]

Josh's comment also suggests that he could benefit from watching other teachers teach in different ways in order to enhance his repertoire of instructional ideas to draw from. Perhaps if the group had a coach who guided them through the process, he or she could have explained to them that the nature of the lesson study is not to be original, but to improve students' understanding and learning through pinpointing to specific problems in a certain classroom and tweaking the lesson to best scaffold the students' learning (Stigler & Hiebert, 1999).

Josh expressed his surprise about the students' ability to understand fractions when it is taught in a hands-on manner. Even though he wasn't sure that the lesson would be a success, this experience convinced him that the hands-on activity is the way fractions should be taught to 3rd graders. Josh expressed some difficulties in class managerial and instructional strategies that could have been addressed had the group did a second lesson study, studying the elements that proved successful and the ones that needed improvement, and taught by a different teacher, a claim Josh raises himself:

> Hands-on learning for 3rd graders and fractions is definitely the way to go. They can manipulate the supplies and conceptualize things more directly. But for some reason, they had a difficult time going from the hands-on to the mathematical terms. Students who knew that the left over strip was not a ¼m or a ½ were still calling it that. They had difficulty storing their understanding and/or going between realms [written reflection]
>
> I was surprised that the students were grasping the concept of the lesson and figuring out the problem, but I couldn't quite figure out how to get them on track.

> We should have practiced the lesson on another 3rd grade class first [written reflection]
>
> It's really hard to see what student learning is going on, whether they're getting it or not, if you're pushing them in the right direction [14, 1:00]
>
> Also, it's easy for me to just talk and talk but this reminds me how important it is to listen to what they're saying and let them make the mistakes. It's consistent across all the groups [14, 2:00]
>
> It was hard to decide how far to go with the paper strips. At first I decided to not tell them to fold it. Looking back I should have told them to manipulate it, tell them all the things they could have done with it [14, 3:00]
>
> As the person doing the lesson I didn't get to observe. So when I walked around asking students what they are doing and a few answer, I consider that successful but there are still some that don't say anything. Maybe those kids are getting shut out… [14, 17:00]
>
> One of the hardest things was to figure out why because that's what I needed to do but I was pressed for time and couldn't figure it out [14, 29:00]
>
> How to instruct how to do such a problem? What's hard about it is that the student needs to understand that 'yard' is the unit as opposed to the whole [2, 12:00]

An interesting conclusion Josh had after teaching the lesson was how students are learning even when sometimes it seems like they don't:

> What also interesting is that as a teacher you get angry when students get off task but actually, that's what they're doing… [14, 45:00]

Another example of learning that occurred for Josh is when the teachers discussed the importance of teaching the denominator before the numerator he said:

> Whether that's true or not, I always focus on the numerator first. I need to switch it… [3A, 17:00]

Interestingly, both Andrea and Josh who had less than 5 years of teaching experience and were the 'novices' in this group, came to this conclusion after a group

discussion where the counter arguer was Nichole, who had more than 15 years of teaching experience and was the 'experienced' teacher in this group.

Themes Emerging from the Group's Lesson Study

The majority of the observed videotaped meetings were spent discussing instructional strategies (36%), student thinking (12%), and the teachers' own math knowledge (12%). However some interesting topics came up in the conversations that uncovered the teachers learning and thinking.

Connecting fractions to real-life experience. Throughout the lesson study cycle, something that was very apparent was how the teachers were trying to connect the fractions to the students' every-day life experience:

> Nichole (20): And that part of cutting it out I feel is natural because kids always have to share. If they can relate what they already sort of know about cutting things up and sharing, then they would probably get fractions a little bit better - relating math to real-life experience. But I don't think they sometimes relate what they do all the time, like a deck of cards, everything you do as a kid, you do with other people, fighting over if it's fair or not... [1B, 2:00]
>
> Josh (2): Yeah, and fractions and fairness go hand in hand [1B, 3:00]
>
> Andrea (3): I think it would be useful using real things. I mean, pictures of things but real things. Like you [Josh] say using the kids or boxes of cookies, whatever it is [3B, 30:00]
>
> Sheryl (11): Maybe real-life situations where they have to deal with fractions [10A, 48:00]
>
> Emma (6): We could show slides of road signs? [10A, 48:00]

Eventually, the group has decided to connect the lesson to a previous activity they have done with the students:

> Emma (6): What about a meter jump? [10A, 49:00]

Andrea (3): What is that…? [10A, 49:00]

Josh (2): Actually, that is a good one. We've already done this [10A, 49:00]

Emma (6): We had them jump meters, like, here's a meter, see if you can jump over it… Just to get used to the length [10A, 49:00]

Student previous knowledge. The literature indicate that Japanese textbooks put a lot of emphasis on connecting lessons to one another and connecting students' previous knowledge as the move up the grade levels (Watanabe, 2001). Throughout the entire process, perhaps also because the teachers were very diverse in the grade-level they taught, the group was putting a lot of emphasis on the students' previous knowledge and the knowledge the students accumulate from year to year, grade level to grade level. For example, When Emma (6) wants one of the goals to be writing a journal, Nichole (20) says: "And we can do that because they're used to it? Doing math and then going to write in a journal? Are we adding a new thing that we need to teach them how to do?" [9A, 36:00]:

Nichole (20): How we do it in the 2nd grade is… and I do use some of these things they say [the manual]. It makes them understand what they're asking them and what is the right answer. We execute it in 5-6 days, spread it out, spend a day on each fraction. How do you do it in the 1st grade [to Sheryl]? [2, 27:00]

Sheryl (11): Take a pie, cut it to 4, color one forth – visually [2, 27:00]

Nichole (20): In the 2nd grade we don't relate anything to that [the number line], it's a whole other concept. It is confusing for me because I'm probably not setting up for 3rd or 4th grade at all… [2, 30:00]

Nichole (20): I know that different grade levels are doing different things. I know in 2nd grade you relate a lot of the things to food, when you act it out you get to see that it's the same whole that you're sharing [3B, 12:00]

Andrea (3): Sometime I do it with those blocks. They like doing that. So they had to work in teams and make a long one but… they're still working backwards [3B, 28:00]

Andrea (3): [To Nichole]: What do they do in 2nd grade? [7A, 40:00]

> Andrea (3): So in 3rd grade, what do you guys teach? [7A, 41:00]
>
> Sheryl (11): I was thinking more about activating prior knowledge along the lines of fractions so if you're jumping a meter, it's the whole thing… [10A, 50:00]

Expectations for student learning. Interestingly, the teachers' sometimes viewed the students' knowledge and understanding as an acquired ability or skill rather than being something teachable. They also kept simplifying and underestimating their students' ability to understand more complicated questions. This could suggest that they either do not have high expectations from their students or that they are not confident in their own ability to teach the students a concept in a deeper way but rather ascribe it to being a practiced skill. Another explanation for such a belief is the invisible cultural nature of teaching (Stigler & Hiebert, 1999), where in the U.S. is based on ample practice of the procedure rather than the understanding of the concept (Stigler et al., 1996):

> Josh (2): I just think that if a child looked at that it would take a while to train… that's like a skill to pick up… [3A, 5:00]
>
> Emma (6): There are three separate questions in this one question. I'm just wondering if… how to explain this to my students, we're used to having things step-by-step [3A, 18:00]
>
> Nichole (20): I know… Our kids… we can't give them compound sentences. They need… [3A, 19:00]
>
> Sheryl (11): Half is the easiest one to remember. To visualize too I think [3B, 8:00]
>
> Nichole (20): But with fractions… with estimating length… that's kind of a skill [4B, 4:00]
>
> Nichole (20): Let's do the easiest thing, our kids need the easy stuff… [6A, 57:00], to which Emma (6) responds: No they don't [6A, 57:00]
>
> Josh (2): I think, from what you're saying, more than half of the class, their minds will be blown if we start with the strip that is greater than 1 unit. I think it would be pretty hard to grasp. I can see they're not getting it… throughout the whole lesson. Because, again, the way that they see fractions as part of a whole, it makes fractions kind of difficult for them, or fractions greater than 1 [8A, 25:00]

The expectations for student learning came up again later in the cycle where the teachers actually realized that making mathematics too easy for the students makes them give up faster when they are being challenged:

> Emma (6): If it's just easy to do math because it's fun and it's easy […] and then they actually hit a wall when it's challenging… you know, kids that assume that they know stuff and that it's going to be easy, and then they get something that's not easy, then they just give up. They're thinking 'oh, I'm not really good at math' [9A, 27:00]
>
> Sheryl (11): If it's been easy for them all along, once the challenge comes up they might even be motivated to work harder… [9A, 28:00]
>
> Emma (6): Because they love being right and correct all the time, they're kind of ignoring the part of the critical thinking already and the problem solving […]. But at some point if they really want to pursue math they're going to want to be able to… [9A, 28:00]

Limitations rooted in the American educational system. Similarly to group 1, this group also expressed some frustrations emanating from the current American educational system, mostly referring to the lack of sufficient time to teach each subject to proficiency and the pressure to achieve high scores on tests:

> Nichole (20): Yeah, if they put the curriculum back the way it was, then most kids would be at grade level [3B, 14:00]
>
> Nichole (20): And I don't really think our kids do really well with fractions. And with what you [Sheryl] do in 1st and 2nd grade, it's kind of pitiful, the amount of little time on fractions, what a whole means never even putting it on a number line and then you guys [Andrea] jump in to adding, subtracting, multiplying, and dividing... [3B, 20:00]
>
> Nichole (20): We do very little measuring in 2nd grade or even fractions. Ten years ago it was a lot more… Now it's cut down [6A, 27:00]
>
> Nichole (20): Yeah, we used to do a lot more too years ago and then they cut that down because of time... [7A, 36:00]
>
> Emma (6): We spend so little time on fractions, you never really get to figure out what the difficult point is [8A, 9:00]

> Nichole (20): Don't know how realistic it is to think that we're going to have all our kids at 6 or 7 to be critical thinkers and cover every area because we are touching on every single math concept for 3 or 4 days each… [9A, 29:00]

In addition, this group was constantly thinking about the pacing guide and the expectations for their students' scores on the tests. So much that they could not stray away to do this experiment freely. When the teachers were thinking about when and how to teach their lesson study on fractions, they were considering preparing the students for the lesson over one or two lessons prior to the lesson study, to which Emma, whose class was the one to be taught responded:

> Emma (6): It doesn't correlate to the pacing chart… so I'm just going to let them do what they've learned how to do… I'm not going to alter or cramp something in before the test. They're supposed to know all the concepts of multiplications by November [7A, 24:00]

Luckily, according to the pacing guide, fractions fell right around the date that the teachers were going to teach the lesson study and they decided to teach it as an introduction to fraction, as it was presented in the Japanese teacher's manual. Still, the teachers' mentioned how they are always a little behind the pacing guide [7A, 21:00]. Still, throughout the process it seemed like the teachers were struggling to amalgamate the lesson study with the pacing guide and the grade-level standards:

> Emma (6): Do you want to do this introduction as our lesson study? It fits with the pacing and it fits in with what the kids need [7A, 45:00]

Positive vs. negative. Throughout the entire lesson study process, a lot of concerns and difficulties were raised, especially by Nichole (20), in contrast to a lot of

positive remarks and attitude that characterized the rest of the group, especially Andrea (3) and Josh (2):

> Nichole (20): I find this a bit contradictory, they (the manual) are talking about how you're supposed to think about the fractions as numbers - we don't do that in 1st and 2nd grade, we don't make the connection with the fraction line. Then it talks about the whole but that 2/3 of a small cookie is not the same as 2/3 of a big cookie so it doesn't relate to the number lines again… because the size of something doesn't have anything to do with the number line [2, 28:00]
>
> Emma (6): I disagree, I think you can compare proportions and number line and it's not contradictory… but I think it's interesting [2, 30:00]
>
> Nichole (20): But you know, this is a translation to our language and some of it doesn't translate because we don't write like [gives examples from the book] [3A, 16:00]
>
> Josh (2): Look at 3 and see if… I kind of LIKE that they do it this way. [reads #3 - asking for the denominator first and then for the numerator]. Wouldn't you normally do the numerator first and then the denominator? Because we do things from top to bottom… [3A, 17:00]
>
> Nichole (20): That's what they're trying to… A fraction is a whole number and this person [in the book] seems to feel like it's not a number. And that somehow… the amount that a fraction represents is a number… [3B, 5:00]
>
> Nichole (20): Alice in wonderland where numbers can be what you want them to be, you know, the number line changes. But fractions should be a fraction [3B, 7:00]
>
> Nichole (20): I can't believe that the manual recommends just giving them the whole, giving the measurements rather than trying to understand what you're actually measuring [4B, 8:00]
>
> Andrea (3): He was having them do it so that they could make sure they were putting the next piece in the right spot, that they weren't wondering if it was 1/3 or 1/5… [4B, 9:00]
>
> Josh (2): Oh, yeah, and I think that helped them to understand that 5 of these make the whole and each of these is 1/5 whereas if it was written out it would be this line means it's 1/5 [4B, 9:00]
>
> Andrea (3): That's good, that may actually help you with fractions [7A, 26:00]
>
> Emma (6): That's awesome, actually, that's a really good way to look at the word decomposition [8A, 29:00]

Interestingly, the criticism in the group came from the experienced teacher whereas the positive reactions came from the novices. Even though participating in the study does not necessarily means agreeing with every aspect of it, watching the videos, it felt as Nichole was not keeping an open mind of the new way of instruction as much as her group mates. Rather, it felt like she is fighting the process and resorting more often than none, to her old way of teaching. In contrast, some of the teachers did embrace the opportunity to try out a new way of instruction and assumed the role of researchers in the process:

> Josh (2): I might photocopy some of these when we get to fractions and see what happens with my kids. See if they can hack it [3A, 19:00]
>
> Nichole (20): It is interesting to teach them what exists between 0 to 1 [8A, 33:00]
>
> Sheryl (11): It would be nice to go back and do it [the lesson study] again… [9A, 5:00]
>
> Sheryl (11): [To Andrea:] Did you say you want to test it out on your kids to see? [11, 31:00]
>
> Andrea (3): Yeah, I'm thinking about it… if I can get my kids to settle down at all… I would really like to try it out on the kids but… [11, 31:00]
>
> Sheryl (11): This would be good in determining if this is too hard for the 3rd graders… [11, 31:00]

Group atmosphere. Although, in general, the group seemed to be very friendly and familiar with each other, and, for the most part, the atmosphere between the teachers was respectful and pleasant, at times it seemed like there were communication problems that interfered with the group's progress and success. It appeared that most of the criticism came from Nichole (20), who were resisting the process at times and challenging its merits, whereas Sheryl (11) took the role of the group's peace maker and the process' advocate as she was trying to push it forward. When something more

negative came up or the group was getting off track, Sheryl was shifting the focus back to the lesson study and the students:

> Nichole (20): You guys don't think I understand what numbers are… [2, 39:00]
>
> Sheryl (11): I think that's why it's so hard for the kids to get [2, 40:00]

Insight and learning opportunities for the teachers. Even though it seemed that the process was difficult for the group at times, some learning did occur for the teachers throughout the process. An interesting question for future studies could be to investigate into the learning of different groups. Does struggling through the process lead to more or less learning than being guided through it?

> Emma (6): [Referring to the videotaped lesson study]: I liked how the one group came up with a really nice answer, and instead of saying… he got the kids to really think through how they got to that answer, not like belittling things but just figuring out what kind of thinking made you get to this answer, like it was a real discussion, like let's figure out why they were wrong, like they were really able to follow each other's thought process. It was really sophisticated [5A, 40:00]
>
> Sheryl (11): [Reading a discussion question from the manual]: Why do you think the instructor chose 2/5 of a meter and 2/3 of a meter as lengths for the strips? [5A, 43:00]
>
> Emma (6): Well, they don't fit in there evenly. You can't just measure it and get the answer [5A, 43:00]
>
> Andrea (3): And the 2/5 […] is a trick way to get you to go backwards, you have to fold it… you see how hard that was for some of the kids [5A, 43:00]
>
> Josh (2): I would say that all these problems that kids have with fractions are problems that we all have with fractions [2, 26:00]
>
> Emma (6): Yeah, so we've been feeding them our problems… [2, 26:00]
>
> Andrea (3): The solution can be a wrong solution but it's still a solution [1A, 16:00]

Differences between the U.S. and Japan. The teachers spent a great deal of time going over the prescribed Japanese lesson study and the teacher's manual, trying to figure

out how much of it is embedded in the Japanese ways of instruction and adapting it to American students. Watching the videos of the meetings, it felt like they were sometimes going back and forth and in circles, in need of guidance and perspective from someone who is experienced in the lesson study process as well as in the Japanese curriculum to help them adapt the lesson study to a lesson they feel comfortable teaching while also willing to explore and take risks with it.

> Sheryl (11): I'm almost thinking they just need more experience manipulating these fractions [3B, 30:00]
>
> Emma (6): I think the second one [pointing to the textbook] the students will be able to manage more than the first one. Working from the fraction showing what the whole is is very difficult, but the other two parts, with manipulatives, I think we've kind of covered that [3B, 30:00]
>
> Josh (2): I wonder if we lived in a metric society, like Japan, would it be earlier to understand fraction? [6A, 23:00]
>
> Nichole (20): They spend 4 40 minutes lessons on just the size of the fractions [8B, 00:00]

As long as the teacher think that a certain course of action results from a way of instruction that is too far from what the American students know, they will hesitate using it and expect failure because they believe their students are not prepared to handle the new form of instruction yet:

> Andrea (3): [To Josh]: You know with the two different fractions, they don't work like that in the book at all so maybe they think they understand really well about a denominator and how it relates, then they wouldn't never made this mistake [3B, 14:00]
>
> Josh (2): They might not teach it… I don't think they teach it in Japan. They may think it's developmentally not appropriate. Because if this [the textbook] is the whole text, it ends there… [3B, 14:00]
>
> Nichole (20): And that makes sense because they emphasize to do it on a linear line and really have the kids understand what a whole means. So why would you

> start adding and subtracting numbers? You would spend much more time than we do on the whole. I don't think they start it till later [3B, 15:00]

Lack of guidance. Watching the videos, one of the problems the group seemed to struggle with was pushing he process forward without proper guidance. Even though Sheryl (11) and Emma (6) had some lesson study experience, the group spent a lot of time in the beginning of each meeting getting into a good working rhythm and advancing in their lesson study planning. Even though the process should not be pressured and a decent amount of time should be allotted for each stage of the process, time in the beginning of each meeting was spent on discussing logistics and scheduling – as much as 37 minutes in video 10A, and remembering what they did and decided on in the previous meeting. The group also spent time remembering what was done in the previous meeting and revisiting many of their previously mentioned discussions [7A, 19:00], suggesting lack of organization and difficulty moving forward and finalizing their course of action. In his written reflection, Josh (2) characterized the process as "herding cats". It seemed as though the teachers needed more guidance throughout the process:

> Emma (6): [Reading from the book]. Are we supposed to refer back to this [Japanese textbook] to see how they're teaching those things? [3B, 11:00]

It was apparent, in the meeting that Bonnie was present in, as per the teachers' request, how significant was her guidance and assistance, not only to the teachers' knowledge about the lesson study process and the Japanese instruction, but also to the effective function of the group in pushing the process forward, making decisions, and establishing a course of action:

> Bonnie: It's a typical Japanese lesson so they pose challenging problems and spend a lot of the time is spent with the kids engaging in those problems, gathering the information, but you can tell that they spend a lot more time exploring than a typical American class. Less information but more time for the kids to... [5A, 44:00]
>
> When the teachers were derailing of topic, Bonnie was trying to steer them back in the right direction: But it still sounds like you guys are trying to decide what you want to do in this lesson [8A, 35:00]

Even though the group followed the guiding questions in the manual, it seems that the presence of a knowledgeable advisor in the Japanese lesson study contributed to this group's progress. Still, it is hard to know whether more or less learning would have occurred with a sit-in coach. Future studies should examine more groups with and without a sit-in coach and do a more in-depth investigation into the benefits of the guidance of an inexperienced lesson study group.

Short-term one-time process. Watching the videos, it became apparent that the teachers wanted their process to be meaningful and beneficial for their students. It seemed like that was perhaps part of the reason that they went back and forth so many times and spent a great deal of time discussing their expectations for student learning, their goals, and instructional strategies:

> Josh (2): [Reading]: Ideally, what qualities would you like the students to have 5 years from now? So… should we spend some time feeling this out? [9A, 9:00]
>
> Emma (6): Them being able to have conversations about the math work that they're doing and […] what they're choosing is appropriate? Because right now I think my students are pretty good with the numerical calculations, like if they know what the formula is, they're fine with doing it, but they don't really go beyond that to make sure they really solved it properly. They just want to come up with an answer and be told that they're right. without being able to evaluate it and see if it makes sense. So critical thinking would be... evaluating the work, right? [9A, 11:00]

> Josh (2): How about using their knowledge of fractions […] without being prompt to, just using it? Thinking of things in fractional parts and fractions as whole numbers… but actually applying them [9A, 13:00]
>
> Sheryl (11): Be able to use critical thinking, apply their math skills, and evaluate whether they use them appropriately. I don't know if evaluate is the right word… [9A, 14:00]
>
> Josh (2): I want them to use what they learned in their lives, their everyday lives. Studies…the mastery of it [9A, 14:00]

It seemed, however, that in order to reach such a meaningful outcome, they needed to teach their lesson study at least twice, in order to see the students' reaction to it and be able to make adjustments and learn from the process. Their inexperience with the lesson study process coupled with their lack of guidance, made the group very unsure in their expectations of the lesson study's success. For this reason, the dwelling and re-honing on the content and expectations to make a big difference for the students in the future was perhaps a bit premature and demanded a better understanding of the process and more than one lesson study taught before the teachers could really consider larger, more long-term goals for their students.

Even though the teachers were clearly enthusiastic and wanted the process and outcome to be meaningful, perhaps smaller, more short-term goals would have been more appropriate in nature for such a short term experiment. It is possible that the teachers' frustration of being indecisive resulted from feeling how powerful the lesson study can be but being unable to extract its potential by working on only one lesson. Accordingly, when they were debating goals for their lesson, Nichole (20) says:

> There's something about keeping it simple, I've learned that we are always trying to pack too much into a single lesson [9A, 35:00]

Disagreement and dismissal. Through the discussions, the teachers had some disagreements that could have been a good source of insight and learning from one another but many times seemed to go unresolved where one teacher 'let it go' and no real discussion of the root of the disagreement was explored. They also had some good questions come up that went unanswered or were not given proper attention, going round and round without addressing the issue raised:

> When the group discussed one of the goals for the students to be journal writing, Nichole (20) points out: But then it becomes not a thing about fractions, it becomes a thing of 'let's shorten the math part so we can accommodate the kids that are copying of the board… Do you understand what I'm saying? [9A, 38:00]
>
> Emma (6): But it's so simple, you're doing the fractions on the number line. Just draw the number line, mark the points where the whole, and then have them write the fractions… can they even do that? [9A, 38:00]
>
> Josh (2): They had to write about it [9A, 39:00]
>
> Nichole (20): Well, that was when they could get him direct feedback. Well, ok. I'll go with you guys [9A, 40:00]

> Nichole (20): What do we hope that their answer would be? 1 and a 1/3 meter? Or are we asking them how much it is over a meter? [10A, 57:00]
>
> Andrea (3): I think what was interesting in the lesson is that it was exactly 1/3 and they could fit the piece into the meter… but they might think it's 4 because there are 4 pieces… We don't have to do a 1/3… [10A, 58:00]
>
> Nichole (20): Well, that's what I'm saying, are we giving them that [showing 1/3 with her hands] to figure out or that [showing a meter]? A 1 and a 1/3 to figure out? [10A, 58:00]
>
> Josh (2): A 1 and a 1/3 [10A, 58:00]
>
> Nichole (20): And you're saying your students would know how to do it yet? [10A, 59:00]
>
> Sheryl (11): I think she's trying to ask, is there a way we want to scaffold the lesson so that it'll drive them towards that direction maybe? [10A, 60:00]
>
> Nichole (20): How do we expect them to come up with an answer if they don't know fractions? [10A, 60:00]

This conversation stopped because the teachers' meeting time is up.

In this group, many times it seemed that it was Nichole (20) vs. the rest of the teachers and it is possible that many learning opportunities for the less experienced teachers were lost. Perhaps with some guidance, an outsider experienced coach could have pointed out and highlighted some of the questions that arose and through a discussion could have created some opportunities for insight for all the teachers.

Interestingly, watching the videos, at time it seemed as Nichole's (20) intuition or inclination was the opposite than the rest of the teachers and vice versa. Whether it was conscious or subconscious, and whether it was justified or not, it was very apparent throughout the entire process:

> Emma (6): So should I focus my teaching on a linear scale? [11, 26:00]
>
> Nichole (20): Yeah, somehow I feel like they really need to get that concept right here, that 1N fits exactly N times into the whole [11, 26:00]
>
> Josh (2): I would say you should teach it like you would normally but the linear steps would be more exploded… [11, 26:00]
>
> Andrea (3): Yeah, I don't think you should teach to this lesson. Just introduce fractions [11, 26:00]

Interestingly, a conclusion that Sheryl reached in her written reflections - that the students lacked experience with such an activity and concepts – was what Nichole was trying to express to the group throughout the entire process. It appears that as the most experienced teacher, Nichole had insight to offer to the group during the planning and it is hard to pinpoint what exactly caused the group to ignore her warnings. One possible explanation is that Nichole had difficulty communicating her ideas to the group in an effective way. Another explanation could be that the rest of the teachers, who

outnumbered her in the group, just didn't see her point and had to learn for themselves by experiencing it in class. A third option is that because of Nichole's negativity in many of her remarks, and her resistance to some of the process' elements, the teachers did not take her comments as seriously and saw it as another negative remark.

Teacher as researcher. Perhaps due to the lack of guidance, this group did not have much confidence in the process and did not fully explore it to find its potential for success. The teachers were very concern about their students' success in the lesson and they insisted on preparing the students in advance for the topic of fractions, even though they chose to use the Japanese introduction lesson to fractions. They also organized the students in advance to heterogeneous groups. In contrast to the other group who raised the same concerns but explored the lesson study without preparing the students in advance, this group did not experienced the insight of seeing the lesson work despite the lack of pre-planning:

> Sheryl (11): Well, that's what we were agreeing to. But I'm kind of concerned about… She [Emma] has to prep them, right? They probably forgot some of the things… [11, 22:00]
>
> Andrea (3): Are you going into fractions yet? [11, 22:00]
>
> Emma (6): That's my question […]. I can kind of customize it [11, 22:00]
>
> Sheryl (11): And she does have to do it because for the 2nd grade knowledge, there's nothing in the 2nd grade curriculum that would solve this whatsoever… [11, 22:00]
>
> Josh (2): Emma has pre-taught this and has set up heterogeneous groups in advance. Will also prepare 'group cards' for each group with directions, sentences starters, jobs within the groups, etc. [12A, 20:00]
>
> Sheryl (11): When we were figuring the answer ourselves, we were drawing on the strips, I'm not sure what the 3rd graders, the ones that are struggling, what they have… what they're pulling from [12A, 32:00]

> Andrea (3): That's why groups are good because they can have someone who will be the leader [12A, 32:00]

Perhaps if they were working with a coach throughout the entire process, they would have been better steered towards the lesson study goals better, since it seems like both the dynamics and the quality of discussions were very different in the meeting Bonnie participated in. An examination of the coaching role might be interesting line of inquiry to pursue in future studies.

> Emma (6): Should I teach them about fractions beforehand and this study is more of a chance for them to do more of the exploratory aspects and kind of apply what they know? More than it being an introduction…? [11, 24:00]
>
> Nichole (20): Yeah, I don't think this can be an introduction to fractions [11, 24:00]
>
> Andrea (3): Well… I don't know. I mean they have information about fractions already [11, 24:00]
>
> Nichole (20): Coming from 2nd grade they've never worked numerically… We don't do any of that. Especially with this new program… [11, 24:00]
>
> Josh (2): What's interesting is if you look at this [the teacher's guide], it's written as if it's being introduced [11, 27:00]

Concluding Thoughts

Overall, the teachers seemed invested in the process and wanted to make it a meaningful experience for the students. They wanted to create an innovative lesson study but also connect it to their every-day demands such as the state standards and the pacing guide. However, since the group was not very familiar and immersed in the lesson study process, these high expectations that they had for the single lesson perhaps hindered the positive impression this group had of it. In addition, the fact that the group only did one

lesson study and knew that they were not going to teach the same lesson to another class, might have also had something to do with this group's outcomes.

The main learning process is in the discussion of what worked in the lesson and what did not and there lay the biggest learning opportunities for the teachers. For this group it seemed that the learning process had just begun after teaching the lesson study:

> Josh: "We should have practiced the lesson on another 3rd grade class first" [written reflection].

It seemed that this group could have benefited from focusing more on the procedure itself, deepening their understanding of it and its objectives, and perhaps their insights would have been greater and more profound. Accordingly, Chokshi & Fernandez (2004) warns that new practitioners may have an incomplete understanding of the practice, or focus on superficial procedural aspects. This could have also been a result of lack of sufficient guidance by an outside coach to highlight important point of discussions and to steer them forward through the process.

Even though the teachers seemed familiar and friendly with each other and the atmosphere was respectful and polite, it seemed that they had some trouble working together as a team. One possible explanation might be the different grade-levels and the teachers' unfamiliarity with each other's mathematical content and appropriate instructional strategies. This became apparent when they spent a significant amount of time describing to each other what they teach and how. It seemed they had some difficulty connecting the introduction to fractions for the students in the 3rd grade with previous knowledge from the 2nd grade and connecting it to what the students will be required to study in the 4th grade. For this reason, the lesson study process can be even

more valuable for this group of teachers who seemed to want to become more familiar with each other's work, connect the grade-levels through their teachings, prepare their students for the transitions between grades, and equip them to get through school more efficiently. Another explanation could be that the chemistry for this group was just not right.

Despite the criticism, the group had many "aha!" moments and seemed to benefit from the experience. It is also important to note that looking into such group dynamics and group interactions, it is very hard to determine whether a certain elements will lead to an improvement or not, whether certain elements function as obstructions or as productive sources of insight, and if they will lead to further commitment from the teachers or discourage them from trying the process again. Thus, terms such as 'successful group' are very complex and the scope of this study does not allow making such determinations, but only allows for more specific questions and suggestions for future research to emerge.

DISCUSSION

This study aimed to explore at the lesson study as an efficient induction tool for novice teachers for several reasons derived from the literature. First, the literature indicates the teacher as the key factor for student achievement (Wong, 2003). Second, it reveals the severe lack of retention problem of novice teachers (Smith & Ingersoll, 2004; Darling-Hammond, 1995). And finally, it points to the power of collaboration between an experienced and a novice teacher for advancing the novice's teaching skills, especially through joint-work in the context of the classroom (Moir & Gless, 2001).

Surprisingly, looking at the videotaped meetings and reading the teachers written reflections, it seems that the lesson study can be a beneficial tool for both experienced and novice teachers. Whether it was an inexperienced novice or a veteran teacher who is set in his ways, the process created discussions about practices that the teachers are conducting intuitively, some of them for years, and allowing other instructional strategies to emerge, be experimented on, and perfected. It facilitates the breaking down of old and new practices as well as students' thinking and misconceptions, and their processing in a deeper way. It also allows the teachers to share their knowledge and experiences. This way, the teachers touch upon topics they would not have otherwise, and experience insight through the process. As the analysis revealed, the teachers have experienced quite

a few “aha!” moments as they talked about things that they have never discussed before as teacher:

> Sharon (26): [Surprised about some of the answers]: The student thinking behind of these answers is very interesting. We assume they just don't understand fractions but maybe they don't have the knowledge of HOW to solve to begin with… [3C, 8:00]
>
> Nichole (20): You and I [Sheryl] teach that fractions are a part of a piece… no wonder kids don't make the leap… They're not thinking literally like a number line. It says that's exactly how we are not supposed to talk about that… [2, 40:00]
>
> Nichole (20): You know, this is interesting because this [in the textbook] is instructing the whole and giving the parts and we take the whole and cut it up into parts, I mean, this is going the other direction. We do that with other stuff… [3B, 27:00]
>
> Andrea (3): Look! We've shown all the mistakes… There are so many different ways you can do this wrong… [2, 13:00]

There were many learning opportunities and the comprehensiveness of the process allowed each teacher to get what they needed from it, different insights and realizations, according to their place in their teaching careers.

The Teachers Own Mathematical Knowledge

The literature indicates that one of the three kinds of knowledge necessary to make teaching mathematics effective is the teachers’ own mathematical knowledge (Lappan & Theule-Lubienski, 1994) and that such knowledge is often lacking for preservice teachers, who, for the most part, have last studied mathematics as teenagers in high school (Cooney, 1999). Interestingly, the videos indeed highlighted some holes in the teachers’ knowledge of fractions as they were solving the problems that they will later give their students. However, it seems that both the experiences and novice teachers benefited from the mathematical practice and discussion that followed.

Furthermore, the lesson study process not only facilitated the time to go over these problems and deepen each teacher's own understanding, but it also allowed the teachers to better understand how their student feel; how, just like them, each student is different in his or her thinking and pace; and how to expect and deal with students' misconceptions. Most importantly, it allowed the teachers to come up with more efficient explanations that cover a larger range of student misconceptions in a non-threatening or judging environment:

> Sharon (26): …That's how students feel… [3C, 40:00]
>
> Sharon (26): I've never seen the explanations of how students think before [3C, 17:00]
>
> Lea (2): I thought it was interesting how the students explained it because I have that problem with my students but the one student said: you draw one less line than the fraction and I thought that is a great way to explain it [5A, 8:00]

The Collaborative Process

According to the literature, the collaborative process between experienced and novice teachers can help novice teachers systematically expand their repertoire of teaching strategies instead of relying on trial and error (Freiberg, 2002). Interestingly, the experienced teachers in the groups seemed to recognize the importance of the collegial learning process as well as the novices (e.g., Sharon's written reflection) indicating, once again, that the lesson study is beneficial for both novices and experienced teachers.

All the teachers in group 1 expressed satisfaction of the collegial learning process. They even enquired about continuing the collaboration in the future. In contrast, although, in general, group 2 expressed satisfaction of the collaborative process, some

participants expressed some difficulty, specifically Sheryl (11) and Josh (2), pointing to the lack of leadership and guidance and the exhaustion and late hours of the meetings (e.g., Sheryl's written reflection). Sheryl (11) also said she felt anxious and at a loss for ideas at times [written reflection]. This indicates that even an experienced teacher can use this brainstorming process. However, feeling anxious is not the purpose of the process and it could suggest a few explanations. Perhaps not every group can create a productive collaborative lesson study. Perhaps the chemistry between the participants must be right and a few attempts are needed to create those effective groups. Another possible explanation might be, as Sheryl (11) mentioned, the lack of guidance of a participating coach. The collaborative process aims to create a non-judgmental environment for the teachers to facilitate growth and if, for any reason, the teachers do not work well together, the process might be rendered moot. It is interesting that such criticism was expressed by Sheryl (11) since she had experienced a few lesson study cycles in the past and was the one pushing to create the group and facilitate the process for the original study. This could perhaps indicate that, in the past, Sheryl (11) did experience a more positive lesson study cycle and therefore wanted to participate in one again but perhaps felt that this group was not as successful in the process this time around.

Still, the contribution of the collaborative process was apparent in the videos and in the reflections since the teachers did learn a lot and did have some insight through the collaboration:

> Nichole (20): Some kids didn't even make the tally. And you [Josh] didn't either. You used your finger. So they were coming up with the wrong answer and I think

> that's really a measuring technique, strategy. And the language felt off. I feel that language would make the connections. I found it extremely interesting [14, 10:00]
>
> Andrea (2): I liked that he also showed that […] because even if some kids weren't saying it, they may have been thinking it themselves [4B, 7:00]
>
> Emma (6): That's awesome, actually, that's a really good way to look at the word decomposition [8A, 29:00]

Teaching as a cultural activity

Stigler and Hiebert (1999) talk about teaching as a cultural activity that is so widely shared that it becomes invisible even to those who teach (Hiebert & Stigler, 2000). This, they claim, can perhaps explain why this profession has been so resistant to change (Stigler & Hiebert, 1999). Stigler and Hiebert (1999) keep on explaining that in Japan, teaching is viewed as a craft or a skill that can be perfected through a structured process, by sharing their practice with other, more experienced, teachers (Stigler et al., 1996), whereas in the U.S., the cultural belief is that a teacher is either good or not and there's not much to be done (Hiebert & Stigler, 2000).

Both groups demonstrated that invisible culture of teaching all through the lesson study process. One example is that the American teachers, both novice and experienced, had a hard time writing the lesson plan for the lesson study, even though they were given a premade fraction tool kit to use and many examples of how to teach the lesson in the teacher's manual and in the example videotaped lesson studies. This is in contrast to the Japanese preservice teachers who are intensively taught how to write and polish lesson plans and how to communicate through them about a topic to be taught, as they will greatly determine the success of the lesson (Shimizu, 1999):

> Nichole (20): Ok, so next - plan. [Reading:] Select a revisory lesson. So, we write it up? It's been a long time since I've written a lesson plan… [10A, 44:00]

More examples include tracking the students by ability and being innovative and original in their planned lesson, both discussed in the following sections.

Such a powerful construct cannot be overcome within a few months and a single attempt at a new program. Future studies should examine study groups that engage for a longer period of time, throughout a whole year or even several years, and conducting multiple lesson studies to try and examine the long-term effects and change in the teachers' abilities, skills, and ways of thinking.

Individuality and Innovation

The literature states that teaching in the U.S. is a highly idiosyncratic profession, in which the teachers need to find their own way. A teacher who is independently organizing curriculum and material, and executing his or her own original lesson is considered an innovative teacher, as opposed to Japan, where an innovative teacher is one who can skillfully teaches the lesson prescribed by the text (Stigler et al., 1996). In addition, in the U.S. teachers have all the authority as opposed to Japan, where the authority lies in the curriculum and routines of teaching (Stigler et al., 1996).

Accordingly, both groups struggled with copying the Japanese lesson study and spent a great deal of effort trying to make it their own. It seemed that the teachers had a hard time separating the notion of adjusting the prescribed lesson and their goals for their students from the notion of creating a completely unique and innovative lesson. Even though both groups were a part of condition 1, wherein the group had to use a prepared

fraction toolkit that the researchers of the original study prepared for them and had ample examples of how to teach the lesson, they still felt as if they cannot just use somebody else's lesson and must put a lot of work in it in order to be able to consider it their own.

The aspect of sharing lessons between teachers could be one of the most significant things that could help novices in the beginning of their teaching career. However, the notion of being creative and innovative that characterizes the American education system, and the U.S. in general, did not allow for this aspect to be fully explored during the lesson study cycle.

As it was apparent in the videos, American teachers, end up working hard only to reinvent the wheel and still experience more uncertainty, while Japanese teachers can focus on improving their lessons in a structured, less stressful process (Stigler et al., 1996).

Isolation in the Schools

As the literature mentions the isolation teachers experience in the schools (Wong, 2004; Stigler, Fernandez, & Yoshida, 1996), the videos reveal that this isolation is not just a social one. Once the teachers go into their classrooms, they have no way of knowing and comparing their own practice with other teachers', learn different ways of teaching and managing a classroom, and see other students and other grade levels. Even though they are able to verbally share ideas and ask their colleagues for advice, they cannot learn from observation, something that the lesson study allows. This aspect of lesson study was so significant for the teachers that they were even considering

videotaping themselves in the future, following their experience of observing the one lesson.

Connecting Students Previous Knowledge between Grade Levels

Winstead-Fry's (2007) concluded that effective induction programs should include common planning time with teachers at the same grade level and content area. Incorporating different grade levels in group 2 indeed made the process harder for the teachers and perhaps if the group was more homogenous in terms of grade level, they would have felt more successful in their lesson.

Furthermore, even though it is impossible to make generalizations after looking at only two groups, it seems that group 2 could benefit greatly if the school organized a structured workshop for all the teacher to learn and understand what other grade levels are teaching and how, and connect in a more concrete way the students' previous knowledge going up the grade levels. This too should be a process, perhaps even a lesson-study-like process where the teachers think about the concepts the students will need the following year according to the state-standards and the pacing guide and work together to get them ahead of time rather than lag behind the pacing guide, as one of the teachers' complaints was.

Tracking Students by Ability

According to Stevenson (1998), while the Japanese acknowledge ability differences among individuals, the tendency in Japan is to ignore it and emphasize that accomplishment can always be increased through effort. That is why the Japanese oppose

any form of tracking during elementary and middle school, since they believe that any effort to separate students into tracks on the basis of ability is unfair and discriminating towards students. They believe it goes against the school's basic goals of having students learn as members of a group.

In contrast, Americans explain the basis of individual differences in academic achievement mostly by family stability and support. Attention is paid to individual differences among children even before they enter school. On the basis of physical and psychological readiness for school assessment tests, parents and future teachers are sometimes even alerted to give special kinds of attention and treatment to the child. Americans introduce grouping based on the level of academic ability and competence in certain subjects. By the seventh or eighth grade, nearly all students are divided into different levels of courses in English, math and science (Stevenson, 1998).

Thus, it is not surprising that based on this cultural inclination, both groups initially decided to group their students into heterogeneous groups prior to the lesson study. They wanted to make sure that there are both strong and weak students in every group, thinking that the stronger students will take the lead and at least one student in each group will identify the solution to the problem. Interestingly, group 1 ended up not using predetermined groups, and as opposed to group 2 who continued as planned and divided the students into mixed ability groups, group 1 came to very significant conclusion on this matter. By not dividing the students into mixed ability groups, watching how this decision played out in the classroom, and through their discussion

about it after teaching the lesson study, the teachers had some very interesting insight that changed their way of thinking about teaching:

> Lucy (1): Also splitting the groups. Ideally you'd want to have mixed groups and we lucked out with mine that they're kind of sitting around each other in mixed ability, but if you're teaching you want to make sure you're not putting 4 kids together that all struggle with division because then they'll be lost [7A, 41:00]
>
> Lori (13): Yeah, so maybe an assigned group [7A, 41:00]
>
> Lea (2): It would be interesting though… [7A, 41:00]
>
> Deborah (18): I wonder about what you said earlier that they can do a lot more than we think they can do, what would happen if we did put them… [7A, 41:00]
>
> Lea (2): That's what I'm saying, because some of those kids are used to depending on the higher kids so it would be interesting to put them in a group where… [7A, 41:00]
>
> Lori (13): Yeah. And these kids are usually really good on the hands-on days. That's their best day because they don't have to explain or write things down. They can just show and their answer would be right there [7A, 41:00]
>
> Lea (2): And I think these kids are used to taking a back seat to the kids who tend to perform well so in a group situation they can very easily just sit there and not say anything and go along with the leaders so maybe creating a group and putting these kids together where they have to figure it out on their own... [7A, 42:00]

Positive Impression of the Japanese textbooks

Both groups have expressed their positive impression of the Japanese textbooks:

> Karen (5): And they focus more on skills than on concepts. They [the Japanese] want them [the students] to know what to do. For us, they're almost memorizing math… and this is what's helpful because if a question is asked a different way, they'd be lost. With those books it's skills so no matter what, they'll learn the skill and they will know what to do. The kids know what to do... the kinds of questions are different as well. For us it's like... I don't know... Let's use those books! [7A, 20:00]
>
> Lucy (1): The other thing with the books, is a lot of things in the lessons is pictures or descriptions of what the process is, and there are only maybe 3 questions at the end to review, whereas our textbooks spends only one page going over the topic and then one full page is practice problems. So there's more in here about what the actual concept is and less drilling them on it. I like that better [7A, 21:00]

These reactions from the teachers indicate that the lesson study process made the cultural activity of teaching more visible to them. For the first time, they encountered a different way of teaching, and through processing this new way vs. their old way, they were re-examining their own instruction through a critical lens.

Even though the teacher's manual intimidated the teachers and, for the most part, they did not go through it thoroughly, I believe that if the lesson study were to become a regular practice, the teachers would have slowly become familiarized with it and accustomed to using it to the point where it becomes a working tool rather than an intimidating liability in the process.

Furthermore, group 1 seemed to use the teacher's manual more efficiently because their coach guided them through the process and pointed them to the relevant sections in the manual when it was appropriate to use. Group 2, on the other hand, had to 'stumble' onto the right section at the appropriate time, which might explain their 'back and forth' problem through the process.

Mathematical Explanations

As the teachers found out during the process, the Japanese teacher' and students' explanations of mathematical concepts exceeded the level that was demonstrated by the American teachers and students. Perry (2000) showed that Japanese teachers provide more extended, complex, and better quality explanations to their students. Perry (2000) points to the fact that, as opposed to the American students, Japanese students hear explanations about mathematical principles and function because of the assumption that

if a student can know why a procedure works and when to use it, he or she will be better equipped to handle novel problems and use this learned procedures versus a student who does not. She also asserts that the teachers' understanding of the mathematical concepts that are taught are, at least in part, responsible for such explanations, since teachers who are better versed at the mathematics they teach are better able to explain the concepts to their students (Perry, 2000). This is confirmed by Sheryl (11) saying:

> Sheryl (11): As a student they explained it to us, I don't remember how they did it but after they explained it I was able to remember that [1A, 5:00]

The teachers in both groups acknowledged the problem of quality their explanations as well as their students and through the process showed better understanding of the mathematical concepts and claimed that their ability to explain them has improved. The teachers even admitted that they need to change their way of instruction to facilitate this higher level of mathematical explanations. As the teachers' own mathematical knowledge and mathematical explanations go hand in hand, the lesson study process allows for that time to go over the problems and concepts, deepen the understanding, and plan for a variety of explanations that stem from the students' anticipated misconceptions. In addition, the attention paid by the teachers to the language they used, something that would have gone unnoticed if it wasn't for the structured process of the lesson study, indicated a learning growth for the teachers in their ability to improve their explanations as well.

Time-Spent During the Lesson Study

In terms of time-spent during the lesson study cycle, both groups spent the majority of their time discussing instructional strategies. As one of the main aims of the lesson study process is to provide answers as to the best ways for teachers to go about their daily work, improving their practice, and what tasks best serve the facilitation of student learning (Fernandez et al., 2003), it seems that the teachers have achieved this goal by learning and sharing new instructional strategies with each other, discussing their expectations for the success of each strategy, and implementing one strategy as a lesson study and experimenting with it. Stigler and Hiebert (1999) stress the relevance of the lesson study to the improvement of classroom teaching because it is dedicating itself to analyzing and improving single units of study.

A large amount of time was also allotted for discussing student thinking – 14% for group 1 and 12% for group 2, and, as many of the teachers indicated, was missing in their everyday work and led them to interesting insight:

> Sharon (26) [Surprised about some of the answers]: The student thinking behind of these answers is very interesting. We assume they just don't understand fractions but maybe they don't have the knowledge of HOW to solve to begin with… [3C, 8:00]
>
> Lea (2): We're so set in that we need to directly teach them and tell them what to do and give them guidelines, but guess what? They're pretty smart… [7A, 17:00]
>
> Nichole (20): You [Sheryl] and I teach that fractions are a part of a piece… no wonder kids don't make the leap… They're not thinking literally like a number line [2, 40:00]

In fact, it seems that the exposure to the new instructional strategies and the discussions of student thinking went hand-in-hand for the teachers, as they came to the

realization that in order to change their students' misconceptions, the instruction needs to change as well:

> Karen (5): And no matter what the answer is, they were thinking… they were trying... Because even though some of them didn't get the answer, I was really impressed. I did not expect that. We thought we were going to go in, it's going to be messy, they're not going to know what to do... and it was just different. And that made me feel: "Oh my god... we're not doing what we're supposed to" because they were enjoying and they were learning [7A, 45:00]

Interestingly, group 1, who had a coach participating in all of the meetings throughout the process, showed that 12% of the time-spent in the cycle was spent on guidance they received from Deborah, whereas group 2, who only had a coach join their team upon request, spent 6% of their time being guided by Bonnie. The relatively large percentage of time spent on guidance for the second group, even though Bonnie only participated in two out of the 15 meetings this group had, indicates the need for such assistance for that group. Accordingly, Lewis et al. (2009) and Chokshi and Fernandez (2004) highlight the need for an outside experts and advisors, as a source of information, guidance, and feedback that are critical to the lesson study process, while still remaining a teacher-directed process.

Group 1 spent a significantly lower amount of time on their own mathematical knowledge – 2% as opposed to 12% for group 2. This might indicate the inherently different time management each group allotted the process – few very long meetings for group 1 vs. many one-hour meeting for group 2. This construct possibly reduced their productive work time, and by the time they were involved in the process, the meeting time was up:

Nichole (20): Well, how are we going to choose one if we don't take a look at the Japanese… [7A, 19:00]
Emma (6): We did take a look at B last time… [7A, 19:00]

This difference in the allotted time for the teachers' own mathematical knowledge could also indicate, although impossible to determine, a greater need for group 2 that was fulfilled by the lesson study. Another explanation could be the more diverse participants in group 2 in terms of grade level which required the teachers not teaching the 3rd grade to review and get updated on the relevant mathematical material.

Finally, another significant difference in the groups' time-spent was indicated by the themes labeled as insight, revelations, and "aha!" moments. Group 1 had a lot more positive remarks towards the lesson study and their process than group 2 – 19% vs. 2% respectively. This could result from the fact that group 1 did the lesson study a second time and then had a long reflection meeting guided by Deborah who was asking specific questions that allowed for more insight opportunities for the teachers. Group 2 did only one lesson study followed by a non-guided debriefing. They did not have the opportunity of seeing the lesson study played out when it is taught by a different teacher or a different time of day. They also did not get the opportunity to be reflective in a constructed and guided way as group 1 did. This might explain the big percentage difference between the groups in terms of insight since most of group 1's insight occurred in that reflective meeting that followed the two lesson studies and the debriefing that they conducted, a meeting that group 2 never had.

The breakdown of the themes in terms of percentage use for each group can be view in appendix C.

Limitations Rooted in the American Education System

As the literature indicates, even though teachers are expected to create active and stimulating learning environments for their students and encourage higher-levels of thinking, appropriate setting are not provided for such an objective (Freiberg, 2002). Accordingly, Both groups have expressed some frustration regarding the current American educational system, which sets very high expectations from teachers on the one hand but very limiting demands such as the pacing guide, 'teaching for the test', and the time for hands-on activities being cut off:

> Sharon (26): It would be nice to teach without the pacing guide [3C, 54:00]
>
> Lucy (1): Yeah, because then your students understand the concept before you move on to the next thing [3C, 55:00]
>
> Lea (2): I don't think they're re-writing the standards any time soon… [3C, 58:00]

Both Sharon (26) and Nichole (20), the experienced teachers from both groups, mentioned how in the past, they were given more time to work with their students on the mathematical concepts whereas nowadays, they feel much more constricted to the pacing guide and the tests that the students have to pass, and how they feel that it is a big loss for the students. Group 1 even discussed promoting change in the American educational system, which indicates their positive impression of the lesson study process and their dissatisfaction of some elements in the current educational system. These limitations made it very challenging for the groups to adopt completely the 'teacher as researcher' lens as they were conducting their lesson study cycle.

This could be a problematic point when attempting to adopt the lesson study as an American practice and one that perhaps should be addressed in order to optimize this

professional development as a tool for instructional improvement. Part of this problem might stem from the clash of sub-systems in the educational system in the U.S. however the scope of this study does not allow the exploration of the sub-systems in the educational system responsible for developing curricula and textbooks, legislating school policies, and dictating the expected outcomes of student learning and teachers' practice.

In order to truly facilitate the lesson study as an effective tool of instructional development, a change should be created in the connections and cooperation of all these sub-systems. Perhaps teachers should be involved in advising the legislators and law-makers in the field of education, and creating a lesson study database could contribute immensely to that end. The teachers' point of view should be taken into account when designing new curricula, but in order to give well-thought advice and create meaningful changes in those curricula, the advice should be rooted in an empirical process which views all angles of the problems after having been tested and revised in the actual instruction settings, namely, the lesson study.

Future studies might want to look at the connections between the sub-systems in the American educational system in order to explore the potential threats to conducive cooperation that facilitate best student learning in the classrooms. Similarly, Stigler and Hiebert (1999) claim that the U.S. lacks a system for developing professional knowledge, sharing knowledge about teaching, and giving teachers the opportunities to learn about teaching.

Teaching the Lesson Study

All the participants in both of the groups expressed their unwillingness to teach the lesson study initially. Interestingly, the most experienced teacher in group 1 and the least experienced teacher in group 2 taught the lesson eventually. It is impossible to conclude from this case study how the teachers' teaching experience affected the lesson study process, if at all. Perhaps future studies can examine the reasons that made teachers not want to teach the lesson, agree or disagree to teach it, and their thoughts and feeling about teaching it in front of their colleagues. Perhaps an examination of multiple cases could shed some light on additional comparisons between different groups and different teachers.

As a case study, it is hard to draw generalizable conclusions regarding the lesson study as an induction tool for novice teachers. However, it did reveal some points that might need to be addressed if the lesson study were to become a permanent practice in American schools. Whether it functions as a tool for novice teachers or as a tool to improve instruction, some elements might need to be accommodated for the process to be as productive and effective as possible.

First, future studies should look into the guidance of an inexperienced lesson study group and the effects of the coach's presence in the meetings. Chokshi and Fernandez (2004) indicated that challenges and misconceptions might rise at each developmental stage of the lesson study implementation and, as indicated by Fernandez et al. (2003), having teachers engage in the lesson study alone does not guarantee

success. However, when challenges or misconceptions arise for the teachers, is there more learning occurring through guidance and coaching or through the teachers' confrontation with the problem on their own?

Chokshi and Fernandez (2004) conclusions state that specific recommendations depend on different groups' specific needs and goals and they advise not to dwell on the practice of lesson study, but rather engage in the process since no one can really anticipate the issues and the solutions that it will produce, alongside reflection of the progress of the group. Accordingly, it seemed that for group 2, the real learning process only started after completing the lesson study cycle where everything was falling into place and the different phases of the process made more sense. This is consistent with Perry and Lewis (2009) emphasis on the importance of a group's sustained commitment since this is a process in which the simpler components are woven in first into the teachers' existing practice, and only later they are able to grasp other more complicated ideas of the lesson study.

As Fernandez et al. (2003) laid out in their study the great difficulty the American teachers had with implementing the lesson study correctly, this study also showed that both groups were hesitant in exploring the lesson study to its fullest extent.

However, it could be that if the lesson study was an on-going process in the schools and the teachers would get more familiar with it, they would feel more comfortable to explore it more freely. Furthermore, I believe that if the lesson study was an ongoing process that the teachers participated in regularly, they would have slowly

gotten to know the teacher's manual very well, learn to use it better, and even optimize their lessons more and more:

> Emma (6): I feel like I should read this on my own so that I come back more prepared [7A, 49:00]
> Nichole (20): And that's the problem I have, I have a hard time reading after school and comprehending… [7A, 49:00]

Thus, it could be interesting for future studies to examine groups that have been conducting lesson studies for longer periods of time in order to see if these assumptions hold and to explore how, if at all, does it change the groups dynamics, results, and feelings about the process.

LIMITATIONS

Secondary Data Set

A few limitations stem from using a secondary data set. First, this study was bound by limited data without the ability to conduct further investigation (e.g., interviews or surveys) to deepen the understanding of the existing data or to revise the analytical plan during the study. Second, because this study used a secondary data set, the possible reactivity and reflexivity factors affecting the participants are unknown. Finally, according to Maxwell (2005), selection decisions, in some situations, require considerable knowledge of the setting of the study. Contrary to that, the data for this study were received gradually and as per my request and thus, the selection of the final groups was through a process of elimination and not a though a process of cohesive knowledge of the original data in their entirety. The research questions were also limited to the available data set and were designed around the slowly growing familiarity of that data.

Interpretive validity

Lack of Inter-Rater Reliability. The qualitative coding of the data in this study is preliminary and done by a single researcher which limits the dependability of the coding framework. However, direct data examples were included alongside all the interpretations

made by the researcher and the entire coded dataset was include as an appendix to allow the reader to examine how the coding categories were applied.

Complexity of Data. A comparison in a small-scale qualitative study is usually not very productive because of the limited conclusions that can be drawn from the differences in the groups. A comparison can also deflect the study towards an analysis of differences whereas the main strength of qualitative research is its ability to elucidate local processes, meanings, and contextual influences in specific settings or cases (Maxwell, 2005).

Framing this study as a comparison between two groups who expressed different feelings and outcomes towards the lesson study process amplifies such a focus but it is also important to note that it oversimplifies it as well for a number of reasons. First, and as mentioned previously, the data present a complicated story in terms of the differences between the two groups, as exemplified in the quantitative data that sometimes contradict the qualitative findings. For example, group 2 sometimes shows an increase in the expectations of the measured variables despite comments of criticism in the teachers' written reflections. Second, there is limited or no information on key differences between the groups, such as changes in the teachers' learning and in the students' outcomes, which might have affected this study's interpretations. Finally, many other differences between the two groups were not a part of this study's focus. Thus the comparisons between the groups in this study were used to begin to explore some of the range of group experiences with lesson study, and not to make explicit claims about what constitutes a positive or negative lesson study experience. Even though the groups

seemed different, it is quite complicated to interpret what these differences mean and future research is necessary to explore some of the questions revealed in this study.

Although this study was able to shed some light on some of the outcomes of the lesson study for the two groups, it is hard to make firm generalizations from this case study. Drawing from this study's findings, recommendations for future research on the lesson study process include looking into more savvy lesson study groups in order to eliminate some of the reservations that came up in this study and eliminate some of the difficulties and limitations that the teachers in these two groups experienced which stemmed from their inexperience with the lesson study process; examining more cases to make a more informed comparison between groups that expressed success vs. groups that expressed failure in order to pinpoint to the possible causes of these outcomes more precisely; and examining study groups that engage for a longer period of time, throughout a whole year or even several years, and conducting multiple lesson studies to try and examine the long-term effects and change in the teachers' abilities, skills, and ways of thinking. Such studies would facilitate a more generalizable theory of the effects of the lesson study process on both novice and experienced teachers.

Self-Reported Data

Although the quantitative data that guided this study were self-reported data, where the teachers reported their beliefs and attitudes, the data provided were used as a source for validating the qualitative findings.

In fact, comparing the individual teachers' mean scores for the three variables - Perceived Collegial Learning Effectiveness; Expectations for student achievement; and

Using and promoting student thinking – contradicted, at times, to the qualitative findings that emerged from the videos and the teachers' written reflections. For example, Sharon (26) expressed great satisfaction from the collegial process of the lesson study. She even suggested creating learning communities that would share ideas and lesson plans and dispense videotapes of taught lesson studies with each other, indicating the strong impression the lesson study had on her. However, her mean score for the variable 'collegial learning effectiveness' has decreased from the pretest to the posttest (3.60 to 3.20).

A possible explanation is that her expectations for this variable were too high prior to the study and the posttest reflected a more realistic yet still relatively high view of her expectations for the collegial learning effectiveness. Another possible explanation is the inability to determine a statistical significance from these scores. Finally, it is also possible that the survey items do not give the same pictures as the qualitative data which are much more nuanced, and more precise survey questionnaires need to be developed in order to reexamine the teachers' beliefs and expectations regarding the three variables.

Limited Time to Conduct the Study

Since this study was bound by a limited deadline, a deeper, more in-depth exploration into the data was impossible. For this reason, an analysis of the end-of-the-meeting reflections that each teacher filled out at the end of each meeting was not included in this study. In addition, more time would have allowed additional views of the videotapes which would have facilitated the extraction of better accounts of the findings in more detail, as it would have allowed for more sample groups to participate in the

study. A longer term project would have allowed for a lot deeper analytic work that could have produced more generalizable findings and conclusions. Future studies could draw from this case study's findings in order to strengthen or disprove its conclusions and enhance the knowledge of the lesson study process.

EDUCATIONAL IMPLICATIONS OF THE STUDY

Teacher Retention and Professional Development

According to Stigler and Hiebert (1999), the lesson study is the ideal context for teachers to develop deeper and broader capabilities. Teaching in the United States is considered a private practice and the implications of such isolation are severe. Few teachers feel as they are developing the profession as well as themselves. As they improve lessons and share knowledge with colleagues, teachers begin viewing themselves as true professionals and as major contributors to the knowledge base that defines the profession (Stigler & Hiebert, 1999). As such, their motivation grows as well. The lesson study is not just another expectation piling up on teachers' workload, as they are required to take more and more responsibilities and to show results, but rather a comprehensive program that provides them with opportunities that they have been denied (Stigler & Hiebert, 1999). This point has been demonstrated by group 1 who, following their experience conducting the lesson study, inquired about continuing it themselves, creating learning communities within teachers and schools, and going up to higher levels of the educational system to present a case for the lesson study process.

Improvement of Instruction and Student Achievement

Even though teachers make decisions and solve problems every day, there is currently no system in the U.S. for them to share their knowledge and experience and use

it for professional development. In order to get better over time, there must be a system to save and present teaching scripts that provide a means of accumulating teachers' experiences and insight (Stigler & Hiebert, 1999). The lesson study is a means to such end and, as mentioned earlier, was demonstrated by group 1's enthusiasm about pushing forward to institutionalize it.

The lesson study provides, through detailed analysis of practice and mutual observations, the opportunities to compare and recognize benchmarks for the improvement of the profession. Such comparisons result in stronger motivation for self-improvement and ultimately produce improved teaching, through concrete means of allowing the teacher to try-out new possibilities in a non-threatening context and the help of colleagues (Stigler & Hiebert, 1999). Furthermore, the lesson study process emphasizes student learning related to specific goals and revises itself with students' thinking and learning in mind (Stigler & Hiebert, 1999) and ultimately enhances students' understanding and achievement.

Educational Reform

According to Stigler and Hiebert (1999), the lesson study has the potential to bridge the gap between educational policymakers, researchers, and classroom practice. In the current U.S. system, researchers are recommending and promoting new practices and teachers are expected to implement them. Similarly, teachers receive advice and recommendations on how to change their teaching from policymakers. However, these recommendations might make little sense in the reality of the classroom and cause teachers to devalue suggestions from outsiders and failing to implement suggested

reforms. It is the teachers who are the ones with access to the information that can drive the system forward and advance the much-needed reform.

Furthermore, In Japan, the lesson study's results are being communicated to teachers within and outside of the school and are described as a sequence of plans, outcomes, and revisions, as oppose to a sum of principles devoid of examples that characterizes the learning experience in the U.S. In such a way, Japan was able to develop a system that does not only develop teachers but also develops teaching in a sharable system (Stigler & Hiebert, 1999).

APPENDIX A - GROUP 1

Video 1
Audio file - Did not listen to or mapped.

Video 2
Presenting the lesson study, going over materialesson study, watching the video.
1:00 - Deborah is presenting the lesson study in a very positive way and guiding the meeting and the process.

2:20 - (Deborah:) We can buy the Japanese textbooks in English here but without the teacher's edition, there is very little in here. The team is very surprised about how thin the textbooks for the students are.

Videos 3A-E:
Going over the Japanese plan, solving math problems, and designing their lesson study

Video 3C

	Kate (0)	Lucy (1)	Sharon (26)	Karen (5)	Lori (13)	Lea (2)	Deborah (18)
0:00	Solving math problems						
1:00							
2:00							
3:00							
4:00	Looking at how students answered those problems.						
5:00							"You can see what they did and it says a lot about how we are trained". And we still do that because nobody gave us THAT kind of understanding of fractions.
						I feel like I got my understanding from teaching…	
6:00							Going over the correct answers.
7:00							Other possible student answers for these problems.
8:00			(Very surprised about some of the answers:) The student thinking behind of these answers is very interesting. We assume they just don't understand fractions but maybe they don't have the knowledge of HOW to solve to begin with…				
9:00				Student thinking			
10:00		Student thinking	Student thinking				
11:00				Student thinking		Student thinking	
				Instructional strategies		Instructional strategies	
12:00		Instructional strategies	Computations rather than thinking	And that's exactly the problem…		Instructional strategies	
13:00							Next the manual talks about what's hard about fractions number sense.
14:00	Reading						
15:00				(Responding to an example in the manual:) Instructional strategies / student thinking			
16:00	Reading						
17:00			I've never seen the explanations of how students think before.	I like it because you know what to target already.			
18:00							Student thinking
							This is great because we don't think about this very much.
19:00			No, we don't! because we're so structured as to "teach the lesson, give the questions…"	The pacing guide… "keep moving…"			
			And we have 31 students..	I'm sure if each of us was given the chance to teach this for 2 months, all the kids would understand and have fun with it, but the problem is we don't have the time.			
20:00							
21:00							Next, let's take a look at the curriculum stuff that they put in here, look through the material.
22:00				Anticipated student learning			Section 2 looks at the different modelesson study
23:00				Instructional strategies			
24:00	Reading						
25:00							
26:00							
27:00							
28:00							
29:00	Taking out the paper strips and trying to figure out how to solve the problem with it.						
30:00							
31:00							
32:00							
33:00					This is hard…		Now I know how kids who don't understand feel…

34:00	Solving the problem and explaining their procedures and thinking.						
35:00							
36:00							
37:00							
38:00							
39:00			Differences in thinking, trying to follow each other's logic				
40:00			And that's how students feel..				And it's not that any of you are wrong… It's just different thinking.
41:00					And that's why it took me a minute too to figure it out.		
					So if you would do it with the class, would you do it differently?		I'd do it just the way we did it.
42:00							
43:00							
44:00		Instructional strategies - They do one page for a 45 minutes period… so they would literally teach this (showing a page) for 45 minutes…		And it's worth it though.			
		But there must be an external thing they use, there's no way you can teach this…		Or maybe they leave enough time for kids to think and figure it out.			(To Lucy:) This is the teacher's addition (showing her)
45:00							
46:00		Instructional strategies				Instructional strategies	Next they suggest we look at unit 16 and look at the green document (translation from the teacher's edition) and see what it means.
47:00	Reading and discussing - bad audio						
48:00							
49:00							
50:00							
51:00							
52:00							
53:00							
54:00				You know, I really like these books. They don't put a lot of pressure, there's one concept with 3-4 questions.			
			It would be nice to teach without the pacing guide.				
55:00		Yeah, because then your students understand the concept before you move on to the next thing.				Instructional strategies	
			Instructional strategies		Instructional strategies	Instructional strategies	Instructional strategies
56:00			So since we're doing a lesson study about how the Japanese are teaching this, we're going to develop a really good understanding of how to teach the concept because unfortunately that is not how we're used to teach it or test it				
57:00				However, there are questions who focus on concept more than standards and this is where our kids won't like it because they're like "ok, I learned the rules, I learned how to add and subtract, but my teacher is going to teach me how to think…			
58:00						Yeah, we never do that.. We tell them "this is what you do: step one, step two…".	
				And even if we give them enough time, here, think, do - 5 minutes tops. If they didn't get it, "here you go".			
			Instructional strategies. It's a shame we can't really do this and focus on one concept.				
		Is this study is something we can present to someone on the state department of education that shows that this kind of teaching is more beneficial than what we have?				I don't think they're re-writing the standards any time soon…	
59:00				It's maybe something to be considered later because people will look at it right?			But you need to do that as a team. It's not something that you as an individual can decide, even if you think you should… it's hard. It need to be district or at least school wide.
60:00			Frustration of the educational system.				

61:00	Going over the Japanese books. Make comment - they really like it.						
62:00							
63:00							
64:00							
65:00							
66:00							
67:00							
68:00							
69:00							
70:00							Next, maybe we can talk together about how we can build some understanding for the students
			So, you want to talk about things that have been done before to teach that understanding?				What we might do to build that understanding.
71:00				Discuss that with an example in the book.			
72:00				The differences between the American and Japanese text.			
73:00	Instructional strategies						
74:00							
75:00							Expectations for student learning
76:00	Reading						
77:00		Instructional strategies	Instructional strategies				
78:00		Instructional strategies	Instructional strategies	Instructional strategies	Instructional strategies		

Video 3D

Going over the lesson study kit, watching the video and starting to plan their lesson

	Kate (0)	Lucy (1)	Sharon (26)	Karen (5)	Lori (13)	Lea (2)	Deborah (18)
0:00	Looking over the material and preparing to plan their lesson.						
1:00							
2:00							
3:00							
4:00	Watching the video of the lesson study						
5:00							
6:00							
8:00							
9:00							
10:00							
11:00							
12:00							
13:00							
14:00							
15:00							
16:00							
17:00							
18:00							
19:00							
20:00							
21:00							
22:00							
23:00							
24:00							
25:00							
26:00							
27:00							
28:00							
29:00							
30:00							
31:00							
32:00			Something we were talking about is that he has 3-4 student talking, and what are the rest 28 kids doing?			I do like how they each have a group working on it. Maybe the time that he's going over the topic is not so interesting but you have to do that… You can't have them do something every minute…	
				But beautiful lesson… he prompted them, he showed them, he didn't start out the way we do…			
33:00						And he let them experiment first and then asked them how they got their answer and they had to explain it.	It feelesson study like it's going slowly but it's really not
				I wonder how much time he gave them though…	It seems like they went all the way through because they were able to write their answers in their journalesson study so they were able to finish the question and write it down		
				I feel like I want to do this as our lesson. Can we?		Don't you think we need to start with one that fits equally just to get the concept across?	
34:00				Do you think we should prompt them the way he did too? It depends if we're doing 4th grade or 1st grade… So, did you like what he did?			
		I thought it was interesting		And do you think we should start with a perfect meter and add the extra part just for the kids to get the idea of how to do it?			
		Yeah, I would say start with it and extend it afterwards.			So that they're able to compare the other pieces alesson studyo.		

35:00		Instructional strategies	Instructional strategies	So we need to choose the grade we teach.		I just don't want to teach the lesson…	
		I don't want to teach it either but you can use my class..		Do you think your kids are ready for fractions?			
	We didn't even touch that.						
36:00	Discussing which class to teach, teaching it twice, and procedural detailesson study						
37:00							We don't need to decide right now who's teaching it but nobody's going be made to teach it. If nobody wants to teach it, I can teach it. The tricky part is not to teach it, it's to actually follow what the plan says and not change it unless it's really falling apart.
38:00							And the lesson is really just a way to look at our plan, it's not the most important part. This is really important, what we're doing now. So it's the whole process that's really important
39:00	Discussing examples from the manual and what they want to do in their own lesson.						
40:00							
41:00							Guiding the group
42:00	Talking about the goalesson study and they way to teach them.						
							There are some goalesson study in the manual
43:00	Talking about the goalesson study and they way to teach them. Karen is typing it up and leading the group forward.						
44:00							Guiding.
45:00							
46:00	Talking about the goalesson study and they way to teach them. Karen is typing it up and leading the group forward. Assigning jobs for each of the observing teachers, how much time to give the lesson, time of day to teach each lesson (doing 2 lessons), scheduling meetings.						
47:00							
48:00							
49:00							
50:00							
51:00							
52:00							
53:00							
54:00							
55:00							
56:00							
57:00							
58:00							
59:00							
60:00							
61:00	Doesn't want to teach the lesson					(To Deborah:) I have a feeling you'll end up teaching the lesson… Nobody wants to teach it…	
					I feel like when you're teaching you're more worried about your delivery and if you're doing it properly but if you're watching you can focus on what the students are saying. That's what I wouldn't want to miss out on		And if teaching it is too stressful, you wouldn't enjoy the process…
62:00	Talking about what to do/focus on in their lesson (content), what materialesson study to use, rationale (students' misconceptions).						
63:00							
64:00							
65:00							
66:00							
67:00							
68:00							
69:00							
70:00							
71:00							
72:00	Talking about what their students suppose to know by now and what they need to know prior to this lesson.						
73:00							
74:00	Discussing how to teach / instructional strategies						
75:00							
76:00							
77:00	Anticipating student response						
78:00						Student thinking	

Video 3E

Following the lesson study manual to fill in and type the lesson plan

	Kate (0)	Lucy (1)	Sharon (26)	Karen (5)	Lori (13)	Lea (2)	Deborah (18)
0:00					Instructional strategies	Anticipated student response	
1:00				Instructional strategies	Language		
2:00			Student thinking	Student thinking / expectations for student learning	Instructional strategies		
3:00						Instructional strategies	
4:00		Instructional strategies		Instructional strategies	Instructional strategies		
5:00			"seems like it's too much though…" / expectations for student learning				
6:00					"So we need to focus on one? Like explain the relationship between the number line?"		
			Instructional strategies / expectations for student learning		Instructional strategies / expectations for student learning		

7:00					Expectations for student learning / student thinking	Student misconceptions and instructional strategies	
8:00			Previous knowledge / Instructional strategies		Instructional strategies		
			Teacher as researcher - If we see the students get it, we can expand next lesson study.	Instructional strategies			
9:00				Planning the lesson			
10:00		Expectations for student learning / Student thinking		Expectations for student learning / Student thinking			
11:00					Instructional strategies		
12:00					Assessment of student learning		
13:00				Goal for students in lesson study	Goal for students in lesson study		
14:00				Typing the lesson plan			
15:00							
16:00							
17:00				"We need to decide on the goalesson study"			
				"Students will be able to identify..?"	"Understand"		
	Talking among themselves..			"Understand is subjective.."	"Is that not ok? That how it is in the manual.."		
18:00				"ok, so understand that fractions.."	"are … and recognize the parts total relationships"	"Should we say something about the students understanding about the paper strips?"	
19:00				Putting Lea's point in. "I think we're good with these 3 goalesson study".			
20:00				Students misconceptions	Students misconceptions		Teacher's math knowledge
21:00			Instructional strategies and student thinking	Instructional strategies and student thinking	Instructional strategies and student thinking		
22:00							
23:00				Rational for the lesson study			
				Previous knowledge and connecting to previous and following units			
24:00				Standards	Standards		
25:00							
26:00							
27:00				Introduction of lesson	Introduction of lesson		Introduction of lesson
28:00				Points to evaluate	Points to evaluate		
29:00			Lesson plan breakdown				
30:00							
31:00							
32:00							
33:00							
34:00							
35:00							
36:00					Anticipated student thinking		
37:00							
38:00			Student previous knowledge				
39:00							
40:00						Said something that Sharon disagreed with and backed down. As they kept discussing, they came back to the point and she said: "that's what I said but…"	
41:00							
42:00						Student previous knowledge	
43:00		Speaks up but kind of gets drowned in the other voices (?)					
44:00		Language			Language	Language	
45:00						Anticipated student response	
46:00						Anticipated student response and instructional strategies	
47:00			Lesson plan breakdown				
48:00							
49:00							
50:00							
51:00							
52:00							
53:00							So we're going to use one meter length but we're not going to call it a meter?
54:00							
55:00							
56:00							
57:00							
58:00							
59:00							
60:00							
61:00							

Video 4
Lesson study 1

Video 5A
Debriefing

	Kate (0)	Lucy (1)	Sharon (26)	Karen (5)	Lori (13)	Lea (2)	Deborah (18)
0:00			I thought the kids did a great job!				
1:00							

2:00			I enjoyed watching them manipulating the strips. We never have time for it.. They were talking among themselves about how to do it.				
		I thought it was interesting to see that groups of kids that I didn't think would got the answer right away did get it and some kids that do have more mathematical thinking didn't get it.					
3:00				I realized that when they used two pieces in a whole they referred to them as halves because they were looking at them as equal parts.			
			That's why we divided the line on the board to equal parts because they didn't relate this to a line. They needed a little more.				
4:00						I was surprised that they used that other piece. And that was good because they were able to understand that if they're using one that is 1/3 and one that is 2/3 so that's 3/3 and that's a whole.	
				This made me realize I need to use more of that. They were excited, they were trying to discover things, and we're usually doing it boring.. So they were involved… and we didn't group them by ability…			
5:00			One thing that was a difficulty was the sign. They had trouble with that. Alesson studyo because it was written in two different ways, and that's why when I wrote my fractions on the board, I did it both ways so they could see the sign was a little deceptive.				
6:00			I feel like at the end, I didn't have a good wrap-up. I feel like I should have done more or something different. I'm not sure. I was pleased with the class, they worked well together. I randomly put them into groups, and that's a tribute to you (Lucy) because they really know how to get into groups because that could have been very awkward.				
7:00					I disagree that you didn't have closure. You brought them back to the number line where you started it, and I thought it was good how you showed them, having the students come up, how to do it properly, cause the one student couldn't verbally tell you, so you had him come up and show you how to do it correctly. I thought you did kind of closed it up.		
		I thought it was a closure.				Yeah.	And closure wasn't hear really (in their lesson plan).
							And they did everything we predicted. They drew 5 lines, and you had to sort that out.
8:00			Yeah, they associated that with the spaces, not the lines. Isn't that interesting?			I thought it was interesting how the students explained it because I have that problem with my students but the one student said: you draw one less line than the fraction and I thought that is a great way to explain it.	
9:00			Student's language in his answer / student thinking				
10:00		Student thinking			Student thinking		Did we tell them they can fold them?
11:00			Student thinking		Student thinking	Student thinking	
		Student thinking					

12:00			I liked how they were all willing to try it. Even though you said you have some students you were concerned about, it really went well. And they were able to come back to where I wanted them to come back.				Yeah, they were really collaborative. For quickly put together groups.
		They liked to talk.					But they all talked.
			Even in the group… everybody was participating. Which I thought was good.		Student thinking		
13:00					And they seem to know from the very beginning "denominator", "numerator"… "total".. So they had a good base.		
				Student thinking	Student thinking		Student thinking
14:00			The one thing that I thought I'd see them do but they didn't…				
15:00							I thought they were really good at estimating too. They alesson studyo did a good job of recording.
16:00				Student thinking			Student thinking
17:00					Student thinking		
18:00					Student thinking		
19:00				Instructional strategies - How would we improve it?			Instructional strategies - change the sign
			Instructional strategies - Change the sign.	Would you do anything differently? Order?			
			I really want a better closure.				
20:00					I thought it was good. Especially since you did it "on the fly"… How would you do it better?		
			I don't know…				Maybe we should change it and see if it goes better.
			Instructional strategies.	Instructional strategies - suggesting a different way.			
21:00			I actually didn't want to do that because they would have immediately find it.		It was good to let them explore.		
			I wanted them to figure it out, I understand what you're saying.		Instructional strategies.		
			Instructional strategies.	feedback to Sharon.	Student thinking / instructional strategies: you really let them explain it to you and if they were having a hard time you had them show it to you		
22:00					Instructional strategies.		
			Instructional strategies	Instructional strategies			
23:00		Instructional strategies	Instructional strategies	Instructional strategies	Instructional strategies		
24:00			Instructional strategies	Instructional strategies			
25:00				Reading everything that was said that she had written down.			
26:00							
27:00	Tweaking the lesson - fixing the sign.						

Video 5B

Debriefing

	Kate (0)	Lucy (1)	Sharon (26)	Karen (5)	Lori (13)	Lea (2)	Deborah (18)
0:00	Telling the, about her student						
1:00	(because they're going to teach						
2:00	them next?)						
3:00							

Video 6

Lesson study 2

Video 7A

Summarizing the lesson study experience

	Kate (0)	Lucy (1)	Sharon (26)	Karen (5)	Lori (13)	Lea (2)	Deborah (18)
0:00							
1:00							
2:00			The difference in the class makeup really makes a difference. So two classes, same lesson, but the different students responded completely differently.	We (the teachers) were seeing the task differently and students are the same way, they think a different way but eventually they reach the same point, so we should consider that while we're planning.			
3:00				Alesson studyo, when we first started working we were very focused and then it went down and when we're teaching we never think about it as well for students.		And tests.	

					During the lesson study I thought it was interesting to see the different groups and how they solve, the strategies that they used. And some kids assumed a role, like a leader, and you don't usually see this when you're doing procedural math problems. so seeing them work together is something that I probably need to do more of to see that group work.		
4:00						What surprised me is that even when you don't give them any instructions and guidelines and steps and they can still do it, they figure it out. Because I thought it was going to be a disaster, they're not going to know how to figure it out but they did ok with it.	Was the lesson completely different then how you normally teach?
	Yes						In what way?
	It was hands-on, we didn't use the textbook				It was open so they were allowed to… there were very few guidelines, so just ask a question and they have to figure it out		
				The kids were really involved, they were very excited. You (Lucy) said it made a difference later when you introduced fractions, right?			
		We were in the middle of doing fractions in our math book and it made the introduction easier to refer back					What do you normally do? How do you introduce fractions?
5:00		For this unit we started with modeling with fraction tiles					
6:00		Alesson studyo, this study itself gave me the perspective of letting the kids have more self discovery through activities first before diving into the lesson because it does make a difference. And we have some manipulatives and that and self discovery really help them.					
	With the fraction it was SO important and especially being first year teachers, we just work from our textbook, and have that prior knowledge of the lesson for our group of kids because we haven't talked about it yet, it was really helpful. And alesson studyo, it gave us that jump start of seeing how it works						
7:00			One thing it made me realize is that, sadly, we are tied to a pacing guide and in prior years, like 10 years ago, I was able, time wise, to use more ?? Than I do now, and I think it's a loss for the students because it gives them more of a practical way to look at their math rather than paper and pencil that are right in front of you and just do it, and I'd like to be able to do that more, start using manipulatives.				
8:00					With that pacing, some of those first lessons using manipulatives were cut off, so we made the decision to still do that. And that is the one day when you can see all of the students actually do that, it's usually their best day. And by skipping that, some of them get skipped so we decided not to skip it but then we're always behind according to the guidelines...		
9:00		Talking about how they ignore the time guidelines of fractions because it's overwhelming.					

	And still I wish we could spend more time on it because it's hard knowing that a lot of the students still don't understand it.	And we have to move to decimalesson study and if they don't understand fractions they won't understand decimalesson study.					
10:00						It's alesson studyo not necessarily not having the time for fractions but alesson studyo jumping from concept to concept. There's not enough time to spend on each concept.	
11:00	Talking about hard topics to teach.	Talking about hard topics to teach.				Talking about hard topics to teach.	Where was your emphasis on the number line? Why did you choose to focus on that?
	It was parts of the material that was provided in the study connecting fractions with number lines						
12:00							So you felt that this representation was something that you really wanted to put into your lesson?
						I think they at some point alesson studyo talked about the different ways to represent a fraction, and maybe they're more used to the proportion way and this showed them the different ways to look at it	
		Especially since a lot of the testing in our books refer to the number line so giving them the pictorial representation would help them transfer the knowledge					Didn't you (Lucy) learn it that week and you thought it was much easier?
		Yes, for me but everyone thinks differently. I'm an algebraic thinker so for me it makes sense to have it that way but…					
13:00							So this was your first lesson study experience (everyone answers yes). So why did you want to do it?
				We always shared but we never had the chance to observe and discuss the differences between prior and after… so we thought it would be interesting to see the different students… it was a new experience and we all know that it is a good idea to do this so we went forward and did it.			And were you pleased with what you got out of it?
				Yes! It's a very good thing and maybe we should… maybe we need to talk to Claire about it.. Yeah, we have to because we learned a lot. I've never had a chance to go to a 4th grade class.			
14:00					To watch other people teach too. We never get to see what other people do. It's weird, this is a profession where you talk about it a lot but we never get to see how it's really done and it was interesting to see that.		
			Another thing about it that we are "program improvement" and we're looking for ways… so our leadership coach told us: why don't you look into lesson study and start observing new lessons and that how we got drawn into it. And I was nervous about it but I was fine. and I enjoyed it. and I would love to see more teachers go observe teachers.				What we've learned from lesson study is that the person who teaches the lesson often learns the most. They're really putting themselves on the spot having to make it through every step of the process, so I think it would be valuable for all of you at some point…
15:00				Actually we were thinking about videotaping ourselves. Even if we can't go observe we can watch ourselves and see what our strengths are, what you need to work on, otherwise, there's no way you can tell..			And it alesson studyo might help if you videotape yourself, to take someone elesson studye with you and watch the tape together.

		I did that last year and it taught me a lot about things I wasn't aware of, things that were good, and things I should change					
16:00							You watched that other groups video doing the lesson study. How do you think your compared to theirs as inexperienced?
				I realized the big difference in the population of the students. We were watching them and think, there's no way we can do it this way but we were surprised because they did better than we had expected. They are better students than we think, they just need the time			
17:00					working together…	We're so set in that we need to directly teach them and tell them what to do and give them guidelines, but guess what? They're pretty smart…	
				And the way we divided the groups, we didn't really think about it, it was just random and it worked! We think we need to really pair them up..	and think they need to interact a certain way…		
			You know, there are learning communities and we need to dispense videotapes and share that and discuss what's going on, and share with our colleagues..			Like Sharon said, we are a part of an improvement program and we've been doing other professional development and we've been learning how valuable collaborative teaching team is .	
18:00							What do you think you get out of lesson study that you don't get out of doing it by yourselves?
						The first thing is that you're more focused, when you're doing it on your own you're kind of all over the place.. But when you're in a group with a specific goal in mind, you're really focused on that lesson, on that goal, on that topic.	
				And you get input from other teachers as well because we always teach the way we learned but when we watched the tape we were like: "oh, that's great. Let's use that". So, more inputs, more ideas.			Is there anything uncomfortable about that process? Collaborating is difficult sometimes… Was there anything that didn't work quite well for your group? (everybody nod "no", thinking about it).
19:00					I think we're used to kind of... we talk all the time, and have lunch together… maybe if you didn't know the people it could be uncomfortable but I felt that we were all comfortable so you can say things and not feel like you're being judged		The binder - I noticed you guys didn't use a lot of stuff that was in there… and I'm curious about the things that you used and didn't use and why?
					We used the Japanese books		
	and the videos						
20:00		We noticed in the textbooks how many pictures there are there and how they will spend a whole day just on one page out of the whole book. Their book is much thinner in compare to ours.		and they focus more and skillesson study than on concepts. They (Japanese) want them (students) to know what to do. For us, they're almost memorizing math… and this is what's helpful because if a question is asked a different way, they'd be lost. With those books it's skillesson study so no matter what, they'll learn the skill and they will know what to do. The kids know what to do... the kinds of questions are different as well. For us it's like... I don't know... Let's use those books!			

21:00							So the books were compelling because they used a lot of concepts, they used a lot of pictures and representations? (everyone nod). What elesson studye was useful about it?
			Agrees with Karen.	They're not scary to students. When they hold them (Japanese books): "oh nice", when they hold ours (American books): "Oh, my god, heavy!!". And it's a lot of things and it's scary. Even the way the questions are asked. In our books, it's really confusing. the kids will be scared. a lot of times the kids know what to do but they don't understand the question and end up failing the test.			
		The other thing with the books, is a lot of things in the lessons is pictures or descriptions of what the process is, and there are only maybe 3 questions at the end to review, whereas our textbooks spends only one page going over the topic and then one full page is practice problems. so there's more in here about what the actual concept is and less drilling them on it. I like that better.					
22:00			I think it teaches more of the different modalities in the classroom when you have a book like this rather than a textbook with a full page of text. 75% of your kids are EL so if it's like that they're able to grasp it better. And it's alesson studyo why they like the hands-on, the manipulatives.			For them it's math and not reading.	What went along with the textbook is the teacher's manual and I noticed that you didn't dig into that very much. And I'm curious about that.
						Maybe it's a little intimidating to have a whole binder full of printed stuff…	
23:00					We used that when we did the lesson template		
			But we didn't go into that to much, we created our own. We probably… could have used that…				
		When we did the number line idea we did look at that specific lesson and we organized it according to how it said the order should be.					And the video - you watched that. Why was that compelling?
					Just to see it in action. it was really interesting. And the kids were engaged so it made you want to try it out, see how it worked.		
			Even though it was a different population of student, just to see how our kids would react to that. I think we were all rather surprised at the results when the kids got involved in the activity. It appeared that everybody had a part in it.				
24:00							Did you use his lesson plan that he planned for the video?
				No, we didn't look at his lesson plan but we took ideas from the video, tweaked it a little bit, changed some stuff. We dealt with a different population so…			Did you see your kids reacting similarly to what you saw in the video?
				Motivation wise - yes. Knowledge wise - they were not as knowledgeable			

			However, they developed really good coping skillesson study. The one with the… finger count, he had his method called "finger count" and it was interesting that they used something that was totally "way out there" and they were able to get the answer and they were happy about that.	We realized that his kids were able to explain how they thought. Our kids knew what to do but they couldn't tell how they reached their conclusions, and it's again a language thing, because most of them are EL (English Learners). So we knew they got the idea but they couldn't tell us how they got it. So we couldn't really see how they're thinking so we used our judgment like babies			
25:00						I thought they did good at explaining it actually. Because they could show you what they did	
26:00				They used some statements that we didn't understand and we asked them what did they mean and they kept repeating the same sentence… so it was hard for them to explain but they were showing it with gestures…			
		Because they're EL, I think they're used to finding different ways to explain things. They couldn't tell you exactly how but they could give you a reason of how they found it that worked. And they didn't know how it worked exactly but they did know (gives example of the finger count).					That's really interesting because it makes us think of what we need to do as teachers to understand what kids are thinking
27:00					And we give them a pencil and a paper and they fail… and they knew it in class and it's because we heard it but the test is not showing that. So that's the hard part - how do you assess…?		
				And you see that students were more worried about right answers than experimenting. They just wanted us to say "good job" so they were afraid of being wrong… so maybe it's alesson studyo our mistake, we have to say "no matter what your answer is…"			
		Because if you think of it.. At the end of everything it is always the test so that's what they're being trained.. That at the end of learning either you get it or you don't. and that all that matters. It's not the process of learning that's important. so I think that is good for us to recognize.					
28:00				There was one group that kept saying that 1/3 is one whole out of 3.. (giving the example she was talking about in minute 26). And this is why the end up not doing well on the test because they always understand it the opposite way…			so what does that mean for your teaching?
				More visualesson study. We shouldn't confuse them with the questions… even though when they get tested on the CSTs it will get confusing so..			
			Exactly! We're torn between what we want them to be able to do and what we know they'll get tested on. There's a big gap there.	We want to teach them but at the same time we want them to do well on the test. Especially since we are under the improvement program so we need them to do well			

29:00					We already have the… preparing them for the CSTs with our testing. Maybe what we need to do is to add some of that hands-on culminating group activity… We can't take away our chapter tests but maybe we need to add more of that type of thing. So that their grade will not be only about what they do on the test but a little more…		
			I agree.	I remember, I had a teacher that used to look at our entire answer, even if the answer wasn't right, we could get point for the way we solved it. We don't look at that, only at the final answer.			
30:00						And when you get to higher grade there are a lot of problems that are multi-steps and you can have it until the last step and then get it wrong. And it's like they did do a lot correct…	
				So maybe we should work on that as well as teachers, look at the way they thought, the process and score them on that as well. This will let them work harder as well because they get frustrated. Some of them fall behind because of calculations..			So back to the binder. Did anybody look at them on their own? Not as a group?
	No.	No.			Yeah, more like glancing through it.	No.	I feel like the reason we didn't get as much into the binder is just time… And how much time did you guys spend on this?
31:00					Planning the lesson took quite a while…		
			That was a full day.				So why did you want to repeat the kind of lesson you saw on the video?
32:00		I think we just wanted to expose out students to the metric system		Because in higher grades they will be exposed to it.			
		And the fact that every other country in the world uses the metric system other then us.. So having them… because I know that's still a weak point for me being able to convert anything into the metric system. It wasn't really taught that much in elementary school and when you get to high school it's really hard. so we wanted to get them to at least see that there is something elesson studye.					And why did you want to teach the lesson twice?
33:00						We thought we had too…	
				No, actually we wanted to see how it would be with a second group…			
			Yeah, just to compare.	And we changed some stuff… There were some error in the first so we thought "let's perfect it in the second".			
	It was a different time of day too.						Karen, you said something about errors in the first lesson. Talk a little bit about that.
		There was the decimal sign.		I remember there were things we wanted to change but I don't remember what they were… Not errors, just some things we thought could be better.			
34:00		Alesson studyo, the numbers had the slash sign (/) instead of the straight line (-) between the numbers and they've never seen that before. And they were really confused about what a fraction was					How did you come up with the sign in the first place?
				It was his (the Japanese teacher) idea.	In the video.		

35:00				But it ended up that the first lesson was better because the students were more ready… It was morning..			
			I thought that the first one was much better. I did make a mistake with what I said but I was able to work it back into the thing.. But there was definite different group dynamic with that second group weather the time of the day or… It was very interesting to do that.				Do you think that the students in both class were able to achieve the goalesson study that you set them out to achieve?
36:00		I think most of them did.	Yeah, I'd say most of them in your class (Lucy). I'm not so sure about Kate's class				How do you know if kids got it or didn't get it?
		I think primarily when we were walking around asking them how they broke it into parts and having them explaining it to us was the primary way of knowing if they understood it or not				They filled out this paper too.	
					But then what happens is when they showed us, they were doing it physically correct but then when they were expressing it in an incorrect way.		
				Again, that's language…	That happened a few times.		
							If you were to share this lesson with another group of teachers so that they can teach something like that, is there anything you would add to your lesson plan or change or make more explicit that would help another group of teachers?
37:00					Maybe just the wrap up.		
			Yes, I was not comfortable with the wrap up.	I would put alesson studyo a formal assessment other than informal assessment maybe with objectives in mind.			
			But then you're going back to paper and pencilesson study which was not what we were trying to do.			They can have both.	
				Because think about it, in normal life they always end up having a formal assessment			
38:00			No, in SCHOOL, they always end up having a formal assessment.				
		We could've given each group a different problem to solve and have them solve it and then come up in front of the group and showed it and that way they were visually showing what they did and that would have been more formal because then everyone would have done one problem	That's a good idea, that would've been a better closing too.				
39:00							
40:00		Alesson studyo just keeping the time of day in mind. I think part of the reason my class was more successful was because it was the first thing. They came in from PE and then that was the first thing that they've done that day. Whereas for her class, they're already been through math for an hour and a half, they've already been a little into language arts, so they've been learning for over 2 hours by the time we got there whereas my kids were ready to go. so just being mindful, in math especially, the kids are more alert early in the morning					

41:00		Alesson studyo splitting the groups. Ideally you'd want to have mixed groups and we lucked out with mine that they're kind of sitting around each other in mixed ability, but if you're teaching you want to make sure you're not putting 4 kids together that all struggle with division because then they'll be lost.			Yeah, so maybe an assigned group.	It would be interesting though…	
					It would but when you're trying to have mixed ability		I wonder about what you said earlier that they can do a lot more than we think they can do, what would happen if we did put them..
						That's what I'm saying, because some of those kids are used to depending on the higher kids so it would be interesting to put them in a group where…	
					Yeah. And these kids are usually really good on the hands-on days. That's their best day because they don't have to explain or write things down. They can just show and their answer would be right there.		
42:00						And I think these kids are used to taking a back seat to the kids who tend to perform well so in a group situation they can very easily just sit there and not say anything and go along with the leaders so maybe creating a group and putting these kids together where they have to figure it out on their own...	One of the reason we decided to do this lesson is that we learn a lot doing that activity ourselves. What did you learn?
43:00				The thing with the strip, we tried to do it ourselves and maybe 2 of us figured it out	we did different things, and it's the same thing because that's not how we're used to do things, that's not how we usually do math.. Or teach math.. So were probably a little rusty at that…		So that struggling thing was a really good experience?
44:00					Yeah, this is why we thought it was a good problem because even we couldn't do it.		
		And when we did it with each other we had to explain how we did it		So we thought maybe they'd benefit from it the same way we did.			You think they did?
				I think they did because they ended up covering most of the objectives. They took their time with the first one and then the second and third ones were easy for them because they got used to the procedure.	Yes.		For the first question, students gave you different answers and it seemed like it wasn't anticipated, you weren't expecting them to give you all those answers. What does that tell you?
45:00						They all think very differently and learn differently.	
				And no matter what the answer is, they were thinking… they were trying.. Because even though some of them didn't get the answer, I was really impressed. I did not expect that. We thought we were going to go in, it's going to be messy, they're not going to know what to do… and it was just different. and that made me feel "Oh my god… we're not doing what we're suppose to" because they were enjoying and they were learning.			
	They were already engage through the whole thing	There was no pressure for them to have the right answer and even though some of them felt like they needed to have the right answer, they were all trying it out. None of them were sitting there intimidated by the task, sitting there thinking: "I don't know what to do". I think they all took on the challenge.					

46:00					even the groups that seemed to have a hard time starting, once they started, if you asked them what did they do, they all had something to say and they all tried different things. It was really interesting.		What was interesting to me was when you started out you were going through the tool kit and were like "whatever", and then started to go over the scripts and you were getting more involved and more excited so that was really interesting to watch.
					We totally forgot we did that.. Because that is what made us choose that. It was doing it ourselves that was really exciting.		
47:00			You know, our children are the same way. I think we need to spend more time doing that. I know I did it with one lesson but I didn't do it enough, I felt that I had to move on. The sense that we're always feeling like we've got to move on… there's a lot of pressure.			That's what I like about our curriculum - every lesson starts with a hands-on lesson. If nothing elesson studye at least get the students to start thinking about it and be interested.	
48:00							Did anything you did through the collaborative aspect of the group lesson study process impact the way you thought about stuff?
49:00			actually yeah.	Yes.			
50:00							And did anything impact what you are going to do in your classroom? Or are you still dealing with this internal pacing guide?
					It made me realize that I want to do that, I just have to figure out how I'm going to do it. And I do have a book with open-ended questions, but it like: "how do I fit it in? Where do I fit it in?". And that maybe can be something we can all figure out because I don't know how by myself. but I realized, not only is that important but I want to do more of that, have that experience. I'm just not sure how.		
			I would love to have the time where we could all talk together. Pick a math topic and come up with ideas just to share and try in our classrooms				
51:00		In a year it builds on what we do, in 5th and 6th grade .					
52:00			And for math in particularly, we have to teach the vocabulary for the test which is the most difficult part because the way things are phrased on the CST is not how they are in the textbook	and every year the kids struggle. So now we know. First thing we teach the, it's either or… it's the same thing.			
			I think we just need to insist on making the time for it.				Has this changed the way you think about mathematics at all?
53:00				Maybe explaining math. not the way we think about math. When we were students we never thought of math the way we do now teaching. We were like our students, memorizing… so yes, we will change the way we're teaching.	There's the math procedure, and there's the computation, and there's the math concepts. So I feel like what we've done with the lesson study is more about the math concepts. And I have to admit I'm kind of rusty because I've been focused on the procedures and computations and I haven't been teaching this way so it's showing me that I don't know how but somehow you have to like: "what is the concept, and don't forget what is the main concept of the math lesson.		
54:00	They're asking Deborah if they can see their pre- and post- test to see if they improved through the lesson study. Talking about their different thinking in trying to solve the questions on the pre- and post-test.						
55:00							
56:00							
57:00							
58:00							

60:00							If we were to promote this to the whole faculty, is there sort of presentation you can come up with.
61:00			Since this is something we got into through the program improvement, I can see taking it back to the staff and do something like that				
62:00						And we really tried to focus on our teacher collaboration. This is what it was all about.	
63:00							

Video 7B

Preparing a presentation summarizing their experience and writing reflections.

34:00 - Karen is summarizing everything they had written in the presentation so far.

APPENDIX B - GROUP 2

Video 1A

Solving math problems, explaining their own thinking and anticipating student answers and thinking

	Nichole (20)	Sheryl (11)	Emma (6)	Andrea (3)	Josh (2)
0:00	As per the manual recommended, the group starts by solving the problems individually and then sharing their solutions and their anticipated responses for the students. When checking the answers, Nichole, Sheryl, Josh, and Emma did the same thing. Andrea had some trouble with the question. Read it wrong/differently. Once she realized their way of thought, she quickly caught on. They're discussing their thinking and misconceptions.				
1:00					
2:00					
3:00		Offers another way of looking at the problem.			
	Explaining her thinking.				
4:00					The algorithm for dividing a fraction by a fraction that we're taught doesn't make any sense, it's just 'just do it' kind of a thing. Explain to me why?
5:00	I can do it but I couldn't answer this question…	As a student they explained it to us, I don't remember how they did it but after they explained it I was able to remember that.			
	Are there other ways of multiplying fraction, like other countries do it differently?			They do, yes.	[Holding up the Japanese textbook:] Let's see how the Japanese deal with fractions.
6:00			Referring them to the students responses in the manual.		
7:00			Realizing only 1/4 of the students were able to give the correct answer. Trying to understand how the students who got it wrong reached their answer - student thinking.		
8:00					
9:00					
10:00	Deciding on the group's rules and roles.				
11:00					
12:00					
13:00					
	Trying to answer the question: Why do so many students find this problem difficult? :				
14:00				Anticipated student response	Trying to explain a student wrong answer. The rest go: "oooh..".
15:00		Trying to explain a student wrong answer. The rest go: "oooh..".	Trying to explain a student wrong answer. The rest go: "oooh..".		
16:00	If they're not solving the problem correctly, is that considered solving the problem?			The solution can be a wrong solution but it's still a solution.	I think the problem with fractions is that the very simplest thing you do with fractions is one of the most complicated things you can do. Finding the common denominator, applying it to the numerator, and then adding them nd then simplifying, I mean, come on… And what's the common denominator of 13 and 8? It's probably going to be 13 times 8…
			Do you think these students were ever asked to estimate these fractions? Maybe they didn't have a lot of experience doing this - Previous knowledge.		
		They have to be able to visualize it.			
17:00				I think that's the hardest thing about fractions - is it close to being a whole or a tiny sliver of it? How do you see it?	
	So why did you guys know what to do automatically? Do you work with fractions? Because if you don't, you tend to forget it. And these kids did something with the numbers… I think sometimes fractions is one of things you learn, but you don't work with all the time. so you have a tendency to remember just enough to be wrong or fake it a little bit…			Used to use fraction at her previous job (not teaching) all the time: "And I wasn't so adapt to fractions until I did that so I can think about fractions because of that. I could see it in my head" - connecting math to real-life experience.	

18:00					For me it wasn't until I was older that I started visualizing and seeing it as a whole. And I think estimation is a skill. You don't even have to know algorithms to estimate but it's something you have to kind of cultivate yourself.
19:00				Yeah, you do.	
			Kids are kind of resistant to estimating. Because they want to have the precise answer. They want to know it's right.		
	Did you estimate as a kid?			No, not at all.	
20:00	I like math, I can do math - if I saw an example I can duplicate it. But I have to say being a teacher teaching the same thing over and over every year, every time it's like: "ah! Now I get it" and it's imprinted in my brain, just teach it and go on to the next unit and go back to it next year.. And I don't know how you'd do it... especially estimate, we do estimate for a day or two and then we move on. In 2nd grade, I don't know about you guys...		It comes up a little bit..		
21:00		My kids are really uncomfortable with estimation. They're constantly erasing and changing their answer a lot.			
	Would kids know at 6 or 7 what estimation means really?			It's kind of abstract, ha?	They probably haven't done it a whole lot or been cognitive of what their doing. I remember the first time I had to do it in high school and it just felt wrong. And then in my adult life I know a lot of scientist and they do tons of estimations, they make lots of generalizations to make their decisions or assumptions. Think about how much more fun fractions would be if you could work with the estimations as oppose to ..
22:00			Alesson studyo, if you expecting a certain answer and it doesn't come out right, you should kind of have an idea about what you're going to get.		
23:00	Solving another problem (guided by Emma reading from the manual): How did you solve the problem and how might students solve the problem? :				
24:00		I'm very visual so I drew a picture… I didn't really use the picture… Something between a half and a whole. So I think would try to draw a pie, divide it in held and get stuck there.			
25:00	I added them as 3/4. Like money. And then noticed, that's too big. And then I noticed it will always be correct if you do the number in the denominator and the numerator one digit apart.		I was visualizing the pie alesson studyo. But I was alesson studyo thinking about a ruler. So the number line is alesson studyo kind of handy.		
26:00					I was doing the exact thing you were doing [Nichole].
				And I was working with fractions that fit on halves, fourths, and eighths. I used a number line in my head.	
27:00			So how do you think the kids would do that?	In the 4th grade we use a fraction bar so we can kind of see it, where is one in relations to the other but it's hard to see those fractions in your head.	
28:00					

Video 1B

Talking about fractions

	Nichole (20)	Sheryl (11)	Emma (6)	Andrea (3)	Josh (2)
0:00	I just have to say that I'm only a 2nd grade teacher and these fractions are on a very basic level. I get it. But when it goes to the parts of the whole I think most kids at this level would do a whole and then cut it up in pieces than visualize this as a set...				What do you mean a set? Like a set of fractions?
	Drawing to answer the question.				Oh, yeah..
1:00	And we do this.. And it makes it much simpler, but we're already [the kids are at a different level of thinking]… And we all went the same way.				I have to say that the fraction bars do help out a lot. Because as opposed to a circle that you have to divide into slivers, when it's a fraction bar, you can see right there that one is the exact same length as the other. And it's so much easier for them than the circular ones.
2:00		You use fraction bars?			Yeah, you don't get to use them?
		No. We use chocolate bars…	But the cool thing about the pie is that you can see… with the bar you don't.. It's hard to visualize how far it's really going and with a pie you always know how close you are to a whole circle.		
	And that part of cutting it out I feel is natural because kids always have to share. If they can relate what they already sort of know about cutting things up and sharing, then they would probably get fractions a little bit better - relating math to real-life experience. but I don't think they sometimes relate what they do all the time, like a deck of cards, everything you do as a kid, you do with other people, fighting over if it's fair or not...				
3:00					Yeah, and fractions and fairness go hand in hand.
			Don't teachers do that when their teaching fractions? Talk about other things - sharing food or..		
	Yeah, we always bring it in an oral way, we don't take fractions to the playground or the cafeteria.				
4:00			[reading from the manual:] What understandings and misunderstandings of fractions might this problem revealesson study?		[To Emma:] You said you're really excited about this question.
5:00			It's a really good way to check if they do get it.		

Video 1C

Student's thinking and misconceptions about fractions

	Nichole (20)	Sheryl (11)	Emma (6)	Andrea (3)	Josh (2)
0:00			[Summarizing:] So we all used a visual image of a whole rather than a set so that's a really important theme to look at, that the set is another way of looking at fractions and none of us did that… And for misunderstanding I think it's really easy to do a spot-check to see if students can understand that because that's really basic for comparing halves...		
	Where are the answers? [looking for the students' responses in the manual].				

1:00			Well, the idea is to first discuss it and then see the answers the students came up with and how much we figured out from it. So if they answer incorrectly, what does that tell us, before we look at the answers?		
	They don't know how to do [??]				They might use the actual digit with the concept of the fraction. So 1/7th might to them seem more than one half because 7 is bigger than 2?
2:00			Now let's see how students really did.		
3:00	Going over the students answer and responding surprisingly to the answers and discussing them. One student used a method that resulted in the right answer but his explanations was new to the teacher. They were trying to figure out if his method would wok consistently. They think it would work in some cases but not others.				
4:00					
5:00					
6:00	They got the right answers but you don't know how they're getting the right answer. It might be that their explanations doesn't make any sense and adding one more to it [the method the student used] isn't necessarily what the kid was thinking.		Kids are thinking of fractions as what they're representing and they're only able to explain it in terms of using math…		
	I think you're right about that.				
7:00					

Video 2

Going over 3 problems and discussing their thinking in solving them, then connecting that to teaching and student thinking

	Nichole (20)	Sheryl (11)	Emma (6)	Andrea (3)	Josh (2)
0:00	"I don't know how to do this without ever having read it or done it before…" Doesn't want to take the lead.				
1:00		Ok, I'll do it. I don't necessarily know what going on either… Took the lead.		We'll figure it out together…	
2:00		Reading the directions / summarizing what they did last meeting			
3:00					
4:00				Ok, so let's start with problem 2.	
5:00	I don't have the book…			You can do it with me.	
6:00	Solving problems / Math knowledge				
7:00					
8:00				Guys, let's talk about this… - student thinking	
9:00	I don't know how to do it.. I should be able to know how to do it.		Confused as well.	Even when I read it, I got confused at first.	I think they don't know what they're being asked and they don't know how to filter out information from the problem.
10:00	We do pies.			Lower grade use fraction bars.	We have the fraction bars.
	What's the right answer? Mine is 9.	6		6. explains what she did.	
11:00	Explains what she did.			Analyzing the thinking.	I think one of the problems is the word "divide". This is what I did… followed procedure. But hesitated because it's not what was taught to do.
12:00					How to instruct how to do such a problem? What's hard about it is that the student needs to understand that 'yard' is the unit as opposed to the whole.
13:00			I did it wrong using the algorithm. So now I know better how to solve it like a 3rd grader. I tried to solve it visually and use equivalence as a fracture.		but you did do it right!
			Yeah, we've done them all…	Look! We've shown all the mistakes… There are so many different ways you can do this wrong…	

14:00	Yeah, but what I did was…	I didn't use the algorithm to solve the problem. I'm a very visual learner so I had to draw it and some of the kids might do it too and I was alesson studyo thinking, for some of the other answers - how would they get 4?	(To Nichole:) But you can do this with a pie.			
15:00				Yeah, when I look at it it's hard for me to connect the answers off the top of my head so I don't know what connections they've made.		
				So now we've solved 3 question so we need to summarize - what is difficult for students when solving these problems.		
16:00				Right… I would have to think about like…	Sometimes a whole something is represented by a fraction of 3/4 of a yard. So that's confusing.	
		They're used to us teaching them to look at the cubes and they don't really understand what we're asking them.			So we use the same language for the measurement as to describe what you're trying to figure out.	
17:00				It's important for them to understand what is the whole unit, what is the denominator. The constant of what is represented.	One more thing is that we're used to greater numbers representing greater things and with fractions sometimes you can have a very big number representing a very small thing . It's very counter intuitive.	
18:00				Next part in the manual requires to make the connections about students thinking.		
19:00	Reading through examples in the manual.					
20:00						
21:00						
22:00						
23:00						
24:00						
25:00		Question: what do they mean by..		I got stuck on this one… It's hard for me to figure out what's wrong with it.		
			(Answering Andrea:) These are examples of how kids understand them and alesson studyo how they misunderstand			
26:00			Answering Sheryl, explaining.		I would say that all these problems that kids have with fractions are problems that we all have with fractions.	
			Yeah, so we've been feeding them our problems…			
27:00	How we do it in the 2nd grade is… and I do use some of these things they say [the manual]. It makes them understand what they're asking them and what is the right answer. We execute it in 5-6 days, spread it out, spend a day on each fraction. How do you do it in the 1st grade [to Sheryl]?	Take a pie, cut it to 4, color one forth - visually.				
28:00	What are you trying to get them to understand?	I had them put squares together and have them color the fractions then match what is equal - trying to visually see by looking at them what is equal of what.				
	I find this a bit contradictory, they [the manual] are talking about how you're supposed to think about the fractions as numbers - we don't do that in 1st and 2nd grade, we don't make the connection with the fraction line.					
29:00	Then it talks about the whole but that 2/3 of a small cookie is not the same as 2/3 of a big cookie so it doesn't relate to the number lines again… because the size of something doesn't have anything to do with the number line.			See, 4th grade is different because number lines are everything.		

30:00	In the 2nd grade we don't relate anything to that, it's a whole other concept. It is confusing for me because I'm probably not setting up for 3rd or 4th grade at all…		We do it…. And they get totally confused…			
	We don't do that at all…		I disagree, I think you can compare proportions and number line and it's not contradictory… but I think it's interesting.			
		The point is for them to learn that fractions are a part of a whole from the beginning.				
31:00	I have that but it's not really something that is done and as you get further with fractions, it's not a big thing on the testing… and they don't really use these math terms. It's mentioned casually but it's not what we talk about. The purpose is to expose them and if they don't get it now, they'll get it later. So we don't really set them up very well...			We can use a fraction bar and it's kind of like a number line so you don't see where it comes from and where it's going.		
32:00					One thing to do is use chocolate bars. Kids like pizza, kids like pie… they like chocolate bars..	
	Again, you're taking something and breaking it up to pieces again thinking of it as a whole and not as numbers. Should I be thinking about it as a number on a number line or as a candy bar and I have half of it?					
33:00				Fraction are always in relations to a whole. It's always in relations to something elesson studye.		
34:00		so even if we do a number line, we have to make sure it's a whole.	The proportions are the same weather you have a giant bucket or a small cup of water. So number lines are the same. I doesn't matter if you count 10 elephants or 10 mice.			
	I just don't see how the number line goes if you're doing different sizes.					
35:00	A number on a number line has an exact point. the number is the same. But what it related to…				I see what you're saying! (aha moment).	
36:00			It's alesson studyo pieces… so quantity…		Because 1 elephant is 1 elephant but it's alesson studyo a part of a herd.. So, the more I do the number lines the easier it gets. I guess because I'm a linear fella… talk about his own thinking.	
37:00	It's just when you talk about number line, to me it should be absolute. And when you talk about fractions, it changes.		But you're just talking about increments.	instructional strategies		
38:00						
39:00	The number of the unit is absolute. What you're using it to describe changes the number line. Which means that you are thinking in terms of a whole and not an absolute number.				A number can be absolute but still a part of the whole.	
			It's just a tool to counting stuff.	like decimal points.		
	You guys don't think I understand what numbers are…			Like 0.1 is a fraction but stand on its own on a number line.		
40:00		I think that's why it's so hard for the kids to get.				
	You and I [Sheryl] teach that fractions are a part of a piece… no wonder kids don't make the leap.. They're not thinking literally like a number line.					

41:00	It says that's exactly how we are not suppose to talk about that…			Next section, the group needs to begin to explore the fraction kit (reading the manual).	Misconception
42:00	Reading				
43:00	We should actually stop because we need to watch the cd to continue.				
44:00	reading and playing with the paper strips.				
45:00					
46:00					
47:00	Yeah.		I think I got it too.		Did you find it?
48:00	reading and playing with the paper strips.				
49:00					
50:00					
51:00					
52:00					
53:00	Explaining how they did it. Emma, Andrea, and Josh got 2/7th, Sheryl did the wrong question, Nichole got the wrong answer but close. Each did it a different way. "that's really cool!".				
54:00					
55:00					
56:00					
57:00					
58:00					
59:00					
60:00					

Video 3A

Looking through the Japanese textbook

	Nichole (20)	Sheryl (11)	Emma (6)	Andrea (3)	Josh (2)
0:00	Assigning roles for the session and discussing what they did in the previous meeting. Continuing solving problems.				
1:00					
2:00					
3:00					
4:00					I think it's kind of confusing because the number is below the gradation.
5:00		But if they were to think about it though the 1 can't be the number…			
	Yeah, you kind of do that with liquids, you can't fill it more than a whole because it'll spill over.				Sorry to be contrarian, but to compare that with your standard ruler…
			Although your ruler often shows the number before the inch mark. Which is so confusing…		
	But this is just the design. I don't think it's actually a measure unless they do some kind of a beaker…				I just think that if a child looked at that it would take a while to train… that's like a skill to pick up… where the gradation is, right? [going to get the beaker]. Let's see what a beaker looks like, but keep going..
6:00	I'm just trying to tell you when it's at that line.	What do you guys think it is? [they all agree on the answer]. They didn't have to [??] but when they move on to 3rd grade, then they stop doing fractions.			[Showing them the line on the beaker is not at the very top].
	So, no wonder the Japanese do it so well, it's more vague.				
7:00		Ok, so now we're supposed to discuss what the similarities between the two problems are and what knowledge of whole numbers might kids bring to that problem.		Well, they all show 3 parts of a whole.	
8:00		Talk about the differences [bad audio].			But it's one whole aquarium.
				Yeah, you don't even look at the numbers, you look at the shapes…	
9:00		I just think that when they give you the numbers and all that information, you're thrown off, you're not thinking about the whole anymore. I think there are different parts to it and each part is specific.			
		[Reading how it's done in Japan:] We think it is useful to examine a curriculum that uses a measurement content to built student understanding of fractions…			
10:00	Reading how the Japanese do it and look through the Japanese textbook.				
11:00					

12:00		They're doing decimalesson study in the 3rd grade…	Yeah.. But no child in my class would ever be thinking that…		
13:00					Explains the instructions in the book. Everybody: oooh…
14:00		Commenting on the way the Japanese do it.	Commenting about a way of explaining something in the textbook: "I wouldn't have explained it like this".		
15:00		Are you saying that you would explain that the numerator is on top?	Explains that in the Japanese book they explain the concept rather than the definition.		
16:00	But you know, this is a translation to our language and some of it doesn't translate because we don't write like [gives examples from the book].	Well, it forces them how to think about it too because if you don't tell them exactly..			
	Yeah, but probably in their language… Their using a term that means [gives examples].				
17:00					Look at 3 and see if… I kind of LIKE that they do it this way. [reads #3 - asking for the denominator first and then for the numerator]. Wouldn't you normally do the numerator first and then the denominator? Because we do things from top to bottom…
	But the denominator is the most important part.				Whether that's true or not, I always focus on the numerator first.
				Really? I don't… I don't know if it's wrong or not but I don't do that.	I need to switch it…
	Some of it is language, it's a little bit awkward. Like, what does it mean [reads a question].		Explains.		Explains.
18:00			There are three separate questions in this one question. I'm just wondering if… how to explain this to my students, we're used to having things step by-step.	I look at the picture and then I look at what they're asking…	
19:00	I know… Our kids… we can't give them compound sentences. They need…		We just need the cute pictures on the side.		
			I like this [pointing in the book].		
		But do they alesson studyo have a notebook? On the side? They write down notes? I think they do.			I might photocopy some of these when we get to fractions and see what happens with my kids. See if they can hack it.
20:00					It's interesting that they show volume in a linear way.
		Ok, let's go back to the tables.			
21:00			I like the [something in the book].		
	Yeah!		Still flipping through the book, liking what she sees.		
22:00					

Video 3B

	Nichole (20)	Sheryl (11)	Emma (6)	Andrea (3)	Josh (2)
0:00	Can we do one together?	Yeah, let's do one together.			Ok.
	Let's do the hard fraction as a number.				I'll read [reading about using a number line for fractions and students misconceptions].
1:00			So using a number line makes it [??]. It shows the relations too…		
	So what's our answer?				The first one is to use number lines when using fractions.
			Including fractions that are greater than one.		…which we call mixed fractions, right?

2:00					The other thing we have to do is task or experience [Reads the example]. So they have to be in situations where they communicate it that way or that you help them communicate it that way.	
				Where it's easier to see… like 2 out of 3 miles that they run. Instead of something like shirts that are already broken up, so maybe use different examples to let them think, so then 3 can be the whole amount and 2 can be another amount.		
3:00		This liter example too.		This can be totally explosive, if we use something like orange juice…	Or another really good example can be if we used one loaf of bread this is a whole unit and we ask how much does it weigh. And it's not an exact number, hopefully it weighs less than a pound and we can say so that this whole loaf of bread weighs half a pound but is it half of a bread? it's a loaf of bread, it just weighs half a pound.	
4:00				Yeah, and then a slice of bread, you cut it into 8 slices, and then a slice of bread is its own thing, right? But then you can show how it's a part of the loaf of bread too. But it can stands on its own.	[To Emma:] Is that different than what you're seeing here [in the manual]?	
			I'm still stuck on this more than 1 thing… I'm thinking if you have 3 shirts and it's 1 whole set, but then after 1, you can have 2 sets of shirts, 3 sets of shirts… That way you're relating it to an eternity of infinite numbers. So that they're not thinking that there's one kind of number line that goes up to 1 and there's another one… for whole numbers…			
5:00	That's what they're trying to… A fraction is a whole number and this person [in the book] seems to feel like it's not a number. And that somehow… the amount that a fraction represents is a number… That seems to be what you're trying to get to. I was having a hard time last time of how you're not supposed to have it being an exact point, but when it changes the story, like 3 shirts, all of a sudden it becomes a fraction but it's bigger than 1, you know?					
6:00		Well, if you have 3 shirts then that's 1 set. But if she has a set, and she has a set, and he has a set, then you can go beyond that. I think just not having a distinction between fractions being something that is less than 1, I mean, you can have fractions anywhere within the whole numbers. [Nichole looks confused]. That's not helpful, ha?				
7:00	Nope!				Well, is that following their [pointing to the book] first student understanding?	
			Well to me, that's that they're getting that it's a number, less than 1 or greater than 1, wherever it is on that line, it still fits on that continuum of whole numbers.			
	Alice in wonderland where numbers can be what you want them to be, you know, the number line changes.	[Bad audio].				

	But fractions should be a fraction.				Should we go to [looking at the book]…
		I think it would work better if we all just discussed it instead of…	Ok.		Ok.
8:00					[Reading from the manual]. So the student's difficulty in understanding might be the same one I'm having right now…
	[Explaining to Josh:] Numbers can always be cut smaller and smaller and smaller. They're infinite…				Yeah.
		Half is the easiest one to remember. To visualize too I think.			
	[Agreeing:] They can be cut again and again and again…				[Reading:] And the same fractional quantity can be represented by different fractions. Yeah, I understand it now. So difficulty seeing [reads examples from the manual].
9:00				An easy way would be taking a piece of paper, folding it in half, then you open it and show it, then you can fold it again and you have fourths, then you fold it again and you have eighths… It's too bulky to do more than that but when I've done it my class, the kids just want to keep getting it smaller and smaller, then they open it up and label the different areas. It gets kind of crazy after a while but they can see how... they all relate them.	It's still a half.
				Yeah.	
			They label them with equivalent fractures?		
				Yeah. So you still have a half but how many 16ths are in that half?	I love that!
10:00		They can draw it too.			Or you can make them… You can write fractions on the board and they would have to write equivalent fractions that aren't in the simplest form.
11:00		Ok, the meaning of the denominator [Next in the manual].	[Reading from the book]. Are we suppose to refer back to this [Japanese textbook] to see how they're teaching those things?		
12:00	I know that different grade levelesson study are doing different things. I know in 2nd grade you relate a lot of the things to food, when you act it out you get to see that it's the same whole that you're sharing.				
13:00		[Reading from the textbook].		These guys don't have any examples of adding two different fractions.	Yeah. Which we do in 3rd grade, right? They have to find a common denominator.
14:00		This is 4th grade…	Maybe they do do it...		
	We didn't used to do it either, It's a new 4th grade concept.		They're pushing it into lower grades because higher grade are not getting math concepts? So if they understood this really well, then in the higher grades they would do better.		
	Yeah, if they put the curriculum back the way it was, then most kids would be at grade level.			[To Josh:] you know with the two different fractions, they don't work like that in the book at all so maybe they think they understand really well about a denominator and how it relates, then they wouldn't never made this mistake.	They might not teach it… I don't think they teach it in Japan. They may think it's developmentally not appropriate. Because if this [the textbook] is the whole text, it ends there…

15:00	And that makes sense because they emphasize to do it on a linear line and really have the kids understand what a whole means. So why would you start adding and subtracting numbers? You would spend much more time than we do on the whole. I don't think they start it till later.	Even if they don't start it till later, how do they get to that point?				
	Well, I think if they have a really good sense of the whole…		Yeah… [Reading from the textbook]. They're emphasizing the denominator.			
16:00					When you add 1/3 and 1/5, you don't get 2/8, you have to figure out the equivalency. That would be the only way of showing on paper…	
	I don't know, I'm thinking in terms of a whole and not linear, and like I said, if you have something, I think it's reasonable to ask a kid: 'take this and cut it into 3 equal pieces'. Or 4, or 6… and start seeing the relationship of… that it gets smaller if they visually see that the pieces are getting smaller.					
17:00					Ok, so here's the problem, you have to get 2 common wholes and say 'you divide it into 1/5s and you divide it into 1/3s, now add two of your 1/5s and 1 of your 1/3 - what do you get? And they'd have to find a way to convert it to a common denominator, right?	
		I'm thinking back to when I learned how to do this, and they just straight tell you - you have to find a common denominator…	Yeah, we never did anything with manipulatives or any visualesson study…			
18:00		Yeah, they just tell you the rules and that's it. And then you just practice.				
	And that's fine and I'm a big believer in doing that but that's not what you're supposed to do in education in America… Because everybody's supposed to go to college and everybody has to compete with these countries… [annoyed].		No, I had no idea what that meant. We're not bragging about the fact that we didn't learn the concept behind it. I learned the rules and I had no idea. So I learned how to divide fractions but I never… until like 20 years after college, that you can visually represent what was going on… until it's not actually useful…		I think it alesson studyo goes back to the question… I know I have a hard time teaching kids who have more difficulty grasping these things because I didn't have difficulty with it […] So I think about it mathematically and not just following the steps… And I think we need to figure out a way to teach it this way [pointing at the Japanese textbook] because maybe not everybody can go in that direction.	
19:00				When my daughter was in 1st grade, she was having problems with math because she had this teacher who was showing them all these different strategies and to her, as an excelled learner of math, she started doubting herself, and she said too many examples because she has already got it, but that's because she has a good math thinking, a lot of kids don't. So the teachers say 'we have to…'.		
20:00	[Example of something someone said:] 'if you don't get the math, find another book because someone will explain it in a way you would understand'. In math there are many many ways to arrive at the same explanation. And you need to find the one that explains it in a way that you get it.			So we're trying to do this with our kids.		

	And I don't really think our kids do really well with fractions. And with what you [Sheryl] do in 1st and 2nd grade, it's kind of pitiful, the amount of little time on fractions, what a whole means never even putting it on a number line and then you guys [Andrea] jump in to adding, subtracting, multiplying, and dividing…					
21:00					I think that alesson studyo being very very concrete… Saying they teach one at a time to proficiency.	
22:00			Right and don't say 'see, it's backwards. the fractions get smaller as the number gets bigger'.		Yeah, don't say that.	
			They should not be thinking that the numbers are going in the reverse order but just understanding that the more pieces that you divide it to, and that's why the pieces are smaller. People are teaching it incorrectly, I guess.			
	And 1st and 2nd isn't probably the best time, I mean you kind of do that in 2nd but in 3rd grade it should really be about concrete stuff, really get into 'look we can get them smaller and bigger', it's almost like a magic trick. And instead you make them do these abstract things with them that they don't get.					
23:00					I think this one [pointing in the textbook] would be really fun to teach as an exploratory, the one that fits exactly 8 times into the whole.	
				I like that too!	How would you do that as an exploration? We put all the kids with 1/3 pieces at one table and get them to figure out how many times one of these will fit to make a whole and the same thing with quarter pieces so that at each table they come to the understanding of that on their own.	
24:00	[Reading from the manual].					
25:00				Trying to understand / explain the logic of the instructional strategy in the manual.		
					Alesson studyo a fraction is a number and not a unit, that's in common for all 3 of them [questions in the textbook].	
	It's an amount, not a number.				It's an amount or a number.	
			But it's not the same with a large cookie or a small cookie.			
	And that's where I read it ahead of time and last week I was having a hard time doing that because with numbers, it is suppose to be an exact… on a number line…					
26:00			but if you have a box of small cookie and big cookies, but you still count all the cookies…			
	We don't have to get in to that… It's just that when I think of a number line and math, I think of an exact location.					
27:00		I'm having a hard time thinking how to get there…				

	You know, this is interesting because this [in the textbook] is instructing the whole and giving the parts and we take the whole and cut it up into parts, I mean, this is going the other direction. We do that with other stuff…			Kind of like our paper meter and our paper strip, in comparing the two we had to think about…		
	Yeah, if you got this much, what is it? How much is a whole?			And that was really complex.		
	We actually never do that in 2nd. Do you do that?			It's sort of… shown to them.	Yeah, like one part is shaded…	
28:00		They don't have to manipulate it? They don't have a strip…?		Sometime I do it with those blocks. They like doing that. So they had to work in teams and make a long one but… they're still working backwards.		
					I just thought of something you can do. You can put 6 students in there, you can say: 'this is 2/3 of a whole, make 1 whole'. And they need to figure out how many more students they need to make up 1 whole.	
				That's a good idea.		
	I don't know if I'm allowed to say this… but we always have one question like that on the state test, they generally throwing one of those in there, I don't know if it's a control test about just that this many students out of a class, kind of what the fraction is. And the kids don't do it that way... and very few get that. But I think it's illegal for teachers to talk about what's on the states test. And it's a big leap for the kids.. I mean, we do fractions, what? 5-6 days... That's it.					
29:00		Yeah.				
30:00		I'm almost thinking they just need more experience manipulating these fractions.			Yeah.	
				Yeah, and I think it would be useful using real things. I mean, pictures of things but real things. Like you [Josh] say using the kids or boxes of cookies, whatever it is.		
			I think the second one [pointing to the textbook] the students will be able to manage more than the first one. Working from the fraction showing what the whole is very difficult, but the other two parts, with manipulatives, I think we've kind of covered that.			
31:00				Instructional strategies.		
		Even letting them draw… the parts.		We should start with something simple like a half.		
32:00	I think even I get stuck with fractions. Fractions uses two numbers in it to be a fraction and we are taught from the beginning that the one number has a value and it's kind of easy to look at, and all of a sudden, you're not using the numbers the way you've learned them and somehow I feel like I should be able to look at a number and say which one is bigger and which one is smaller but why? Why should you know how to do that without being able to do something like you [Sheryl] said, putting it on something called grid.					
33:00		You have to walk through the problem to figure out the answer.				

	I can figure it out but I think when someone asks you a question, you think, I can figure it out, but when they ask you about fractions, I feel like I want to respond the way I always do, but I don't know that without analyzing it or thinking about it.	Yeah.			I do. I do it.
	Why?				I don't know why but when I do but if I look at [two fractions] what I do is say […]
34:00	So you're converting them, you are doing something with them.				and if I get confused I draw a number line.
	That's what I'm saying.				
35:00					

Video 4A

Reading the summary of the Japanese lesson study and watching the video of the Japanese teacher teaching the lesson.

Video 4B

Going over discussion questions from the manual

	Nichole (20)	Sheryl (11)	Emma (6)	Andrea (3)	Josh (2)
0:00		How does the instructor uses the 1 meter strip? Why does he use 2 1 meter strips to show 2 meters?		I think he was showing how the number line was continuing, adding on so it can be 1 meter, 2 metes, 3 meters… Can't think of any other reason except than make them think of more than 1.	
1:00		Well, that strip was a little over a meter. But did he use to compare to the two strips?			I think that if he had done one strip, then mark it, than used the same strip like a ruler, that that would queue them that that was a way to do it.
			The solution…	Giving the answer up?	Yeah.
2:00		He used 2 meters though, right? 2 strips of 1 meter?		Yeah, he was sticking those up on the board.	
	Doesn't understand.			Explaining to her.	Explaining to her, demonstrating visually with a ruler.
3:00	And kids, sometimes, if it's longer than 1, they just want to go to 2. And having the 2 up there can show them that it's more than 1 but less than 2.				Well, maybe that was it too.
				[Reading:] Why does the instructor have the student predicting the length of paper before investigating?	
	Predicting is a higher thinking skill, isn't it?			Yeah, gets them thinking about solving the problem before they actually see it otherwise they could see it and then…	
4:00			I don't know, maybe he wants to pre-expose them to fractions.		
	Why do we always have people estimating? I thought that what we do in our level is, when you have an answer, become aware if it's in the ball part…		If it's reasonable…		
	But with fractions… with estimating length… that's kind of a skill.			You still have to kind of think how many of these things fit into this, you have to think it through. I think it's just to get them focused on the question in a way and maybe pulling out what they already know about fractions.	
5:00			Do you think kids can come up with a reasonable estimate of fractions anyway? Like, can anyone say 'it's about 1/3'?	Oh, yeah. Kids just have that sense.	
6:00		[Reading:] What elements of instruction might help students build a strong mental image of the connection between the units and the whole?			

	Just like they did. Hands-on. They're actually accounting for it.			Yeah, when they do the cutting to little pieces, I really like that. Then I alesson studyo liked when she said 'there are 4 little lines' and he put the lines all close together: 'you mean like that?' and then they have to think…	That was really good. And alesson studyo that they were actually physically units.
7:00		And he set them up so that [bad audio].	Ooooh…	Oooh, yeah!	Oooh, yeah! Oh, and one more thing. He showed in the beginning with the signs, that one of the places was 1/4 of a whatever… but that it's a unit so if you're familiar with how long a mile is then a 1/4 of a mile, in your mind is a unit.
				I liked that he alesson studyo showed that […] because even if some kids weren't saying it, they may have been thinking it themselves.	[Reading:] This veteran instructor made two changes from the strategies recommended by the teacher's manual. He gave the students strips representing just the fractional parts rather than the whole length, and he did not pre-draw the lines on the 1 meter strip to show half a meter etc. I don't think he made these choices...
8:00			I think they were focusing on the relationship of the length instead of being distracted by the fraction..?		
	So they weren't looking for… just trying to find that number, instead of like finding the answer, they need to see that this goes into this - how many times. I can't believe that the manual recommends just giving them the whole, giving the measurements rather than trying to understand what you're actually measuring.				
9:00			Maybe they think it is faster that way, if you only have 3 days to do fractions 'we're going to just show you instead of…'.	He was having them do it so that they could make sure they were putting the next piece in the right spot, that they weren't wondering if it was 1/3 or 1/5…	Oh, yeah, and I think that helped them to understand that 5 of these make the whole and each of these is 1/5 whereas if it was written out it would be this line means it's 1/5.
10:00				Instead of the actual space in between.	
	Well, you're focusing on the whole rather than 1 piece. And I think that if you focus on the whole, it's easier to get that [bad audio]. But did you guys see the next thing, that if we're pressed for time, maybe we should watch the video at home and discuss it later…				
11:00					

Video 5A

Watching the second videotaped lesson and discussing it.

	Nichole (20)	Sheryl (11)	Emma (6)	Andrea (3)	Josh (2)	Bonnie
0:00						
1:00						
2:00		So the next thing would be to discuss what was done last time.				
3:00	I think it would be interesting, it has to do with the journalesson study, since with focusing on science this year, it might be interesting to see math journalesson study.					
4:00						
5:00						
6:00						
7:00						
8:00						
9:00						
10:00	Preparing the video to watch together. Reading first the summary of the lesson.					
11:00					[While reading to himself:] That's cool.	

11:00					[While reading to himself] That's cool.	
12:00					[While reading to himself] Oh, cool.	
13:00						
14:00						
15:00						
16:00					Before we start, does anybody want to do the video things? We have to choose a question if we do, each one of us has to choose a question.	
	Why, where did you see that? We did that last week…				So do you all want to do them or not?	
17:00				Yeah.	Ok, so we all have to choose a question.	
18:00				So are we each supposed to pick our own…?	Yeah, which one would you like to do?	
		I kind of like discussing it because everyone has his own… I mean, we can write it down to remember what to discuss later on, but I still think it would be good going through it just discussing it…		Instead of writing it down?	Ok.	
19:00						Bringing the laptop for the group to watch the video.
20:00 21:00 22:00 23:00 24:00 25:00 26:00 27:00 28:00 29:00 30:00 31:00 32:00 33:00 34:00 35:00 36:00 37:00 38:00 39:00	Watching the video					
40:00			I liked how the one group came up with a really nice answer, and instead of saying… he got the kids to really think through how they got to that answer, not like belittling things but just figuring out what kind of thinking made you get to this answer, like it was a real discussion, like let's figure out why they were wrong, like they were really able to follow each other's thought process. It was really sophisticated.		Did you see what it said for the objective on the board? 'we'll work as a group to attack problems'. That's what they were doing. They were definitely working as a group.	
41:00		[Reading from the manual]. I like that.		They're saying [bad audio]. I like that.		
42:00		That's to expose them to [bad audio].			I guess in math lessons we don't always break it down into the words, what does it stands for, why does it stands for that… I'm trying to do that more but I remember when I was a kid I was a little confused about the abbreviations. I just got confused here when I was reading it, it said 'he handed them a 3rd strip' and I had to read it again…	
43:00		He kind of assumed that they all know the ways of expressing that length… It's easier for some…			Alesson studyo, then, every time they read a word problem, at least some of them will have the context from when they heard it in class.	
		[Reading a discussion question from the manual:] Why do you think the instructor chose 2/5 of a meter and 2/3 of a meter as lengths for the strips?	Well, they don't fit in there evenly. You can't just measure it and get the answer.	And the 2/5 […] is a trick way to get you to go backwards, you have to fold it… you see how hard that was for some of the kids.		

44:00		Asking Bonnie a clarification question.				It's a typical Japanese lesson so they pose challenging problems and spend a lot of the time is spent with the kids engaging in those problems, gathering the information, but you can tell that they spend a lot more time exploring than a typical American class. Less information but more time for the kids to...
45:00				When I was teaching, just a simple thing where I knew there were several different ways to getting to it, because we were doing multiplications […]. I decided to let them... put it up on the board […] and I got 4 kids to come up and do it 4 different ways and I was like 'wow', it wasn't a hard thing but I looked around and I saw kids were doing it in all kinds of different ways but they were too shy so I said 'there's no right or wrong' just to show... and it was the first connection I had with this a little bit, like 'oh, I don't have to be on top of them every second' and they like that. some of them don't usually come up because somebody already done something and their was different, but they went up, and some of it was good. It is different, we don't have that amount of time to push it all in...		
46:00						
47:00					Do you think he chose these numbers alesson studyo because they have odd denominators? So that, if you're using a half of a strip, a half of an odd denominator… it get's a little… it could be really confusing with fractions.	
		[Reading from the manual:] What kinds of understanding does the instructor try to build?				
48:00			They were looking at the 3/5 as a being the whole.			
49:00					That fractions can be determined or expressed and alesson studyo that looking at mistakes, you can figure out why you make the mistakes.	
50:00		I liked how, with the mistakes, they were able to learn something from it. When they said 2/3 and a half of a 1/3 and another student said that if you use the meter strip it doesn't fit exactly […] and they all kind of strayed from that because they didn't relate it to the meter strip.				
51:00			And they were sort of correct, they came up with something that was correctly calculated. They were comparing it to the standard that they had already. So they were right on with figuring it out.		I multiplied that out and it's 2/3, yeah [The correct answer the students got to].	
			Isn't that funny?		Yeah. Which gave me the question: did they know how to multiply fractions.	

52:00			Well, then they're building up, if they do get to that it'll make more sense, right? Because they've worked with it, I guess.			So for the kids it was their first introduction to fractions.
53:00		[Bad audio - mentioning the 7 meter strip the instructor used].	And then actually making a 7 meter strip… it's really… and read all the journalesson study…	It was 7 meters but it wasn't folded so it was nice, they didn't have any indication of where the marks are going to be.		
54:00		There's one more lesson, one more video.				
	It says that we can watch it later, it doesn't have to be right now.					
55:00					Gives an example from his class.	
56:00	Doing reflections					
57:00						
58:00						
59:00						

Video 5B

Reflection writing.

Video 6A

Choosing a focus for the lesson study.

	Nichole (20)	Sheryl (11)	Emma (6)	Andrea (3)	Josh (2)
1:00	Scheduling				
2:00					
3:00	Reviewing the rules				
4:00					
5:00					
6:00	Reviewing the previous meeting.				
7:00	Going through prescribed lesson with 2 paths - A and B.				
8:00					
9:00					
10:00					
11:00					
12:00					I feel lack of originality, I just teach it the way he taught it. So I'm wondering, do we want to brain storm on a different way to teach the lesson?
13:00	Depending on what grade we decide to present it to, we should decide on something that's level appropriate.		For 3rd grade path A is more appropriate.		
	We don't do fractions at 2nd grade…	So path A.	So unless we do 4th grade…?	Path A.	
14:00				Students pervious knowledge and understanding in 4th grade. A ruler is basically a number line separated into fractions. So the second grade has been introduced to it.	
15:00			I'm not sure if students see the paper strip like a ruler and the measurements as the fractions of the ruler so they'll be thinking about whole numbers on a number line. Student thinking.	student thinking.	
16:00				This is the hardest for me… They talk about fractions as numbers, I can't see them as anything other than numbers so why is it a question? What other way would they be thinking of it other than a number. Maybe this is where I don't understand student thinking…	Student thinking
17:00				What would they call it?	"A part of a number"..
		We need to change their mind set so that when they see a fraction, they don't just see it as a part of a number. And that they could use a number line and find the exact spot of the fraction.			

18:00	But it is a part of a number…		yeah, like in decimal point, but with fractions we don't see it as much.		Another thing is that you can divide 1 whole into 1/5s.. They'll need to do it in later grades but they're confused because we don't do it in a way that is concrete, we just go straight to the algorithm.
19:00	Example (the amazing race)				
20:00	Why are fractions so much harder to think about than whole numbers?				
21:00		It's not clear cut…			Students thinking and misconceptions.
22:00					Example (supermarket)
23:00	Instead of a one level of operation, it turns it to 2-3 steps problems.				I wonder if we lived in a metric society, like Japan, would it be earlier to understand fraction?
				I don't know because then they're only dealing with base 10. With inches and feet we're dealing with a bigger range of numbers.	
24:00					(Handing out rulers:) Try to find 5/8ths of a centimeter and 5/8ths of an inch. It's so much easier..
25:00	Because this (metric) was created by a scientist and this (inches) was created by somebody's body…			Because I'm so used to inches, it's like a language to me. This (metrics) is so much more foreign to me.. But if I used it, it would become easy because it is easy…	
26:00			Example from class. Student thinking.		
27:00	We do very little measuring in 2nd grade or even fractions. 10 years ago it was a lot more.. Now it's cut down.				
28:00					One more thing that make this (metrics) easier is that you're only dealing with 10s or halves. But on this side (inches) each one represents a fraction and it's not labeled at all. So it makes me think that as a 3rd grade teacher - I would teach it like…
29:00	It's confusing to do two measuring systems at the same time. We teach 3 days on this and then turn the ruler over and teach 3 days on this… We're the only country in the world that does this…				
30:00					
31:00					The other thing I was thinking in terms of linear and fractions is that we have the fractions bars which I like a lot.
				Yeah, the 4th grade uses them all the time. Fraction strips, fraction bars…	
					So what I usually do is…
32:00					But I was thinking for the lesson have them set it length wise…
	You can use colors		Or several sets		
			Brainstorming instructional strategies for the lesson study		Brainstorming instructional strategies for the lesson study
33:00	"You 3rd grade teachers and your conversations…"				
34:00	Reading and discussing prescribed lesson, students' thinking and misconceptions				
35:00					
36:00					
37:00					
38:00					
39:00					
40:00					
41:00					
42:00					

44:00					
45:00	Reading path A				
46:00	(To Josh:) I'd like to see some stuff from your unit and then have us look at these books (lesson study prescribed).				Goes through the unit.
47:00					Realizing it's not linear.
48:00					Finding a mistake in the textbook? (fractions cannot be a length).
49:00					It's still a part of a whole, and it never goes beyond the whole.
50:00	Going over the prescribed schedule and exercises.				
51:00					
52:00					
53:00	Looking at the Japanese book. Liking the new ideas in it.				
54:00					
55:00					
56:00	We need to change this so that it fits our measurement unit (inches). We're teaching to the test so…				
57:00	Let's do the easiest thing, our kids need the easy stuff…		No they don't.		I think we should definitely work in metrics.
58:00		What if we pose a few questions and that would be our lesson? Let them figure it out.		Yeah, with the paper strips, have them experiment	I like the idea of the folding. Them folding things that don't have numbers on them, and figuring out what the fraction is. But not all of the class will be able to do it.
59:00					
60:00					

Video 6B

Reflection writing.

Video 7A

Going over the prescribed lesson study and choosing a topic and a grade level to teach

	Nichole (20)	Sheryl (11)	Emma (6)	Andrea (3)	Josh (2)
0:00				So, I think we decided to use [??]. Who's leading this…?	
		Can we briefly talk about, when we finally have a lesson drafted, how much time it's going to take because we still have to do a post-test for the teachers, a post-test to the students, debriefing if we're going to do it immediately after the lesson…			
1:00				I kind of want to plan to do the lesson on a day that we can all meet after school for the debriefing because then it's fresh…	
2:00	Scheduling.				
3:00					
4:00					
5:00					
6:00					
7:00					
8:00					
9:00					
10:00					
11:00					
12:00	[reading what they decided to work on last time:] Knowing what is the whole, constructing the whole when given a fraction, and keeping track of the whole. And the other one was…			… The meaning of the denominator, different units have different sizes, the more units the whole is partitioned into the smaller the units…	
13:00		Let's start with fraction size.			
14:00	Yeah, those are our 3 choices.				
15:00				So we've decided on Path A. Let's read the paragraph about what Path A is.	

16:00				So, it looks like they're telling us we can either use one of the Japanese units to replace… introducing fractions, or we can use our own unit and kind of change it.		
17:00					What is a Japanese unit? A meter?	
		[holding up the Japanese textbook].		No, the 3 fractions…		
	I thought we are going to bring a 3rd grade math book and…					
18:00					[Looking at the manual and reading:] So they're [the Japanese manual] making suggestions for us… and read the 4th grade fractions unit.. Did we already do that? And then we can look over the translated insights that the Japanese teachers made… [reading]. So do you think maybe today we should take a look at those?	
19:00	Well, how are we going to choose one if we don't take a look at the Japanese…		We did take a look at B last time…			
	We only looked at the one part that they told us to.			Well, it's a small unit.		
		Look at this [flipping through the teacher's manual]. Look how many pages this is. Are we reading this too? We need to go over all of it…		Oh my gosh, it's huge…		
		Decimalesson study and fractions, do you guys want to do that?				
	No, we're not doing that because we're doing…		But they're linked here.			
20:00				So, do you guys want to decide what we should look at first? Because we can look at this [student textbook] or these [teacher's manual].		
		Let's look at this one [student textbook] first…		Yeah, and then we can look at 3B a little more…		
			Reading and making comments, reading the example in the book in a funny voice.		Reading and making comments, reading the example in the book in a funny voice.	
21:00	I'm not sure what we're doing, I don't understand… What am I looking for?			I was just following this [manual]. They're suggesting to explore more. So this is some of their suggestions of what we can do so we were thinking we should read those.		
		In chapter 7 they talk about volume. Do we want to deal with volume?	No.			
22:00		Do we want them to chart on the number line even? Improper fraction?		I don't think we want to go anywhere close to improper fractions.	I don't think so, no. But if you look at page 44, there's something really useful that could be more interesting	
				Do you teach improper fractions in the 3rd grade?	We do.	
		Equivalent fractions?		I do it in 4h grade and it's hard.		
23:00	[Reading the recommendation from the manual]. Are we doing 3rd grade? Do we need to introduce them to linear concepts or is that something they already know? Because that's not something their coming out of in 2nd.				I don't think they did it in 2nd, I don't think they know …	
			Are we doing your class?			
	So do you feel like your kids… That kind of determines what we are doing.		This is going to be our first fraction thing of the year, so we're starting from scratch.			

24:00	Well, we don't do linear coming out of the 2nd grade, we haven't done linear at all, that kind of solves that we need to do an introduction. Don't you agree?			Yeah, we have to do an introductory.		
		Well she [Emma] can alesson studyo prepare them for it too because, depending on what the objective is…		Oh, you can start a little ahead of time maybe a little bit. When are you doing fractions?		
			I don't know, we're still doing…			
	The test thing is next week according to this rate.		It doesn't correlate to the pacing chart… so I'm just going to let them do what they've learned how to do… I'm not going to alter or cramp something in before the test. They're supposed to know all the concepts of multiplications by November.			
25:00					[looking at the pacing guide:] I think the fractions don't get introduced until February…	
		So what's in January?			Fractions start actually January 11th.	
			Oh, that's not bad. Perfect.	That's right on target.	[Reading the schedule for fractions in the pacing guide]. Of course that's according to the pacing guide.	
26:00			And we're always a little behind that…	Do you want to use that?	I do.	
				That's good, that may actually help you with fractions.		
			Yeah, it should. They should end up being better at fractions than anything elesson studye…			
		If we want her to introduce it we need to maybe discuss the concepts she need to cover before.				
	[Looking at the textbook:] If I remember correctly, it's stuff that they are able to handle.					
27:00	Looking over the textbook.					
28:00		They could be quoted on the number line [showing the example in the textbook].		So, it sounds to me like we think that the 3B is doable but I don't know, we haven't looked at this one [holding up the other textbook].		
	Yeah, it says to look at it before you make a decision.				I think it's pretty…	
				Too dense?	Yeah.	
					We need something like the exercise on 46.	
29:00		Do you want to do something like equivalent fractions? Because I think you [Nichole] mentioned it's…		Yeah, equivalent fraction… I like, remember when we talked about 1 over N?		
			And we can have prepared strips that fit in? I think if we added 12… A meter divided into 12.. We can then have strips that are 6 or 4 thirds or fourths and they could find ways to reach that?			

30:00				Because…. We were talking about improper fractions. And even though in the lesson that we want, he [Japanese instructor] went over the whole, it was more them understanding a fractional piece, right, than improper fractions? So even though he used the idea of something being more than a whole, it wasn't really to teach about improper fractions. Improper fractions is so hard that I don't think it's something we should do in the beginning. I don't think we should go there at all.	I think you're right.
				And the equivalent fractions, I'm not sure if we should… I mean, that's a possibility.	
31:00		But they can see that while they're… [gesturing].			
	So look at the bottom of 45.				[Reads from the textbook:] It's bigger…
				What's wrong with thinking bigger?	Because it gives you the child impression that there's size… or… it's not the proper terminology…. greater and less.
32:00				Showing examples of terminology of all terms in the textbook.	
	I think it's very good because it seems to be all about testing and you never know what language they're going to use.			That's true. It's really true.	
	Sometimes the kid actually knows it, they just don't know the language that's being used.		That would be the argument for using…	I just gave a quiz, and it wasn't that they couldn't do problems, but it was the language… and I expect that…	
33:00	And 5, 6, 7 year olds using academic language all the time.. Makes them feel like they don't understand what we're talking about… But it doesn't mean that they can't do exactly what we're asking.			Exactly!	
		They might understand the concept but once you're filling out the academic board, it's like 'what did she say?' They are processing some of it differently.			
34:00				It is. It's hard. So we like a lot of these ideas, we like the idea of preparing fractions, equivalent fractions…	
	For the equivalent fractions, he [Japanese instructor] used the things you [Emma] want to use.			But then they alesson studyo have baseball and stuff, they're really nice.	I like those too.
				And I'd really like them to use those big [gesturing the strips]… building up fractions… finding the fractions themselves.	
		Do we want them to do note taking too? Of what they learned?		I don't know… Wouldn't they be doing their work…	
35:00			I don't know if you'll be able to fit it into one lesson.		
		But you can introduce that before the actual lesson, have them summarize what they've learned, put it up on the board…	We could get them into the habit of math notebooks because they have the science notebooks. That'd be nice.		
	They make a big jump here too [looking at the textbook]. In the 3rd grade book there's like 4 pages and then in the 4th grade book there's a whole bunch more.			That's the same for us too.	

36:00	Yeah, we used to do a lot more too years ago and then they cut that down because of time…			So then, should we alesson studyo look at the teachers manualesson study? I don't know how we should… we're getting really focused on that one [textbook]. I don't feel very focused myself… What do you guys think? Should we discuss the direction [in the manual] we're going to do right now and then this [other manual]?	By the way, if you look at the challenge on the bottom of page 51, it looks really cool.
37:00	Instructional strategies.			Guiding the group through the manual suggestions. If we think we know the specifics of our research lesson we can skip to section 4. So do we think we know the specifics of our lesson yet? You guys want to talk about it?	
38:00					Sure.
	[Reading out load from the manual].			I think we might want to take a look at the teacher's manual grade 3.	
39:00				We have some ideas but we're sort of spread out though.	
		What is this about measurement…?			
	We already decided not to go there so do you really want to revisit it?	I just want to know in term of setting up fractions, the progression of the fractions in order to get to this point… Because in 1st grade we just teach them 1/4, 1/3, 1/2 and that's it.			
40:00				[To Nichole:] What do they do in 2nd grade?	
	It's an important concept that when your denominator and numerator match, it's equivalent to 1, and comparing a little bit. But they don't do anything unusual, they kind of stay in the standard 1/3, 1/4, shading it, and we do sets and wholes. We go both ways. Very quickly…				
41:00		So when we get to 3rd grade, we're going to do this 3rd grade lesson…			
	Is that comparing? In 2nd grade we do 2, we don't do 3. You know, which one is [laughs] bigger / greater / larger…?			So in 3rd grade, what do you guys teach?	
			Everything… They're suppose to do adding and subtracting, comparing…		
42:00	Doesn't this [the pacing guide?] show you the year before and the year after? [Reading] Oh, there it is. And I've never used... We've got a totally new curriculum this time.		Is that the standards?		
43:00	Standards.			[going over the standards for grades 2, 3, 4].	
44:00	Can we do all this with fractions? We do all this and it seems like in the Japanese thing they want to make a real big sense on the linear thing and you realize, once they get to reducing them, it's just about adding, subtracting and multiplying, they don't want you to know that beyond...		Yeah, the operant level.		
	I'd like someone to show me on the linear thing how to multiply…		You just add them up and it works really well.		
	Really?		Let's teach them multiplying fraction!	No, no… that's not even until 5th grade.	
		Well, we could if it's at their level.	We don't have enough…		We're not going to be there yet…

45:00			Do you want to do this introduction as our lesson study? it fits with the pacing and it fits in with what the kids need.	Introduction to what?		
			They're taking mystery strips and figuring out the length of them.			
	What's the fractional length? 12 1/4… [flipping through the textbook].Cool pictures! Better than ours. [Reading the objective].					
46:00				[Reading out load].		
	It's using fraction strips to describe fractions [going over the direction].			[Going over the direction for the lesson in the book, comparing it to the video they watched].		
	[Handing Emma the book:] You guys are the 3rd grade teachers…].					
47:00					[Showing them a multiplication problem with fractions on a little board].	
		1st grade teacher: Seemed like didn't know how to do it before he showed it to her.		4th grade teacher: Seemed like she knew how to do it already.		
	2nd grade teacher: 'I still never understood how when you multiply numbers in fractions, they get smaller. When you multiply something it gets larger'.			Explaining to her.		
			Explaining to her.		Explaining to her.	
48:00	Yes, I know it and I get it, I just never understood it. Because when you multiply something… that's what the word multiply means. More. And somehow when you do fractions it makes them less.	You're multiplying parts.			I love it. I think it's cool.	
			And then you get the thing of fraction actually being a division problem waiting to happen so if you convert it to decimalesson study instead it would make more sense.			
49:00	I want to see you on the tape giving the lesson.				She might not be the teacher.	
	Oh, she will be.		You're going to love teaching my kids.	Well, partly we want to do a lesson, the concepts, we're used to them, but how do me make it so that we're using some of that Japanese curriculum in it? So, taking it out of our comfort zone, in a way.		
			I feel like I should read this on my own so that I come back more prepared.			
	And that's the problem I have, I have a hard time reading after school and comprehending…					
50:00				And the grade 3 one is probably the one we're going to be looking at the most anyway. But this might give us some good ideas.	Well, first of all, look at the anticipatory set for this. It's personal, it's the kid measuring his arm spend. It's something to consider, the kids measuring their own arms with a strip, how do you express that? I think that most of our kids' arms are longer than a meter, that would be...	
				Is it?	I'm going to get my meter strip.	
				Instructional strategies.		
51:00		But wouldn't it be chaotic to have so many different ones? Shouldn't we do… oh, let's just measure the teacher's arms.	We can use the one kid.			
52:00	On page 60, what do you guys think of the size of the fractions?		[Reading aloud].			

53:00					[Reading the manual and the textbook] Dang, with this sequence teaching and evaluation plan, we don't do anything… let's take the next 7 weeks off… we got the book, we got the plan…	
			So would we want the kids to learn the first point first, before the lesson?			
	Well, I think they should do something off camera, learning a little bit before we do something like that.	Yeah but, which point are we doing?	With the second point being the size of fractions…			
54:00	Ok, time's up.		For the next meeting, I think we should all read this.			
55:00						
56:00						
57:00						

Video 7B

Reflection writing.

Video 8A

Choosing a topic to teach

	Nichole (20)	Sheryl (11)	Emma (6)	Andrea (3)	Josh (2)	Bonnie
0:00				Last week we had a difficult difficult meeting where we couldn't get our focus about… the transition… we're doing what they're telling us and all of a sudden it's on us.		
		Yeah. We have a few concepts we would like to observe but… It's just a matter of working on it.		Yeah, exactly.		So you have some big ideas that you want, you just have to see how to make it into the lesson.
		And we were supposed to… on our own read Path A… and I couldn't focus.		I didn't have time to look at it.		Maybe today we should look at Path A and you should share.
1:00				Did you guys look at it at all?		
	No.		No…			
2:00		So, before we start… [Reading the group's norms which are read at the beginning of every meeting and assigning roles].				
3:00		Who wants to read?			I'll do it.	
		Ok, let's review what we did last time. We talked about the big ideas and we wanted the kids to order the fractions from least to greatest.		We talked about the start of things.		
4:00	We looked at the manual, remember?	And then we said we wanted them to see that the bigger the denominator, the smaller the size of the fraction, and have them compare fractions, equivalent fractions…				
5:00			1 goes into 1 N times.			
		And then we want to hook them in by having them measure arm spend. And then to have fractional parts pre-cut… we were considering that, how to express fractional parts. And then we were supposed to go home and read Path A but we didn't.				
6:00	Well, the reason we wanted to read Path A is we were having a hard time realizing what the path was so we thought…	Bonnie's here so…				If you have specific questions…
					I think at first, weren't we having a hard time kind of straying away from the lesson he gave?	It's ok, you don't have to do that. You can do that…
		Depends what we want to see, right? If we want to see whether the kids at [school's name] can do this.				
7:00						Or pieces of it.

				We're alesson studyo teaching a younger group…		
		Because it was a 4th grade that we watched.				No, it was 3rd. 3, 4, and 5.
		Oh. Because the only problem is we don't have the 4th and 5th graders to kind of guide them along too. Because we're working in groups.				I can tell you that… it would be interesting to see… [a video of another school's 2nd graders who did a lesson study pilot].
8:00		So we can do the first lesson that he did…				If those meet your goalesson study but you can alesson studyo do a different one.
		Well, we can look at his lesson and adjust it.	I think we're talking about comparing and ordering fractions because that's something our kids were struggling with but any of the… the meaning of the denominator is a useful one too.			So comparing and ordering fractions, is that a place where they have difficulty?
9:00			You know, we spend so little time on fractions, you never really get to figure out what the difficult point is.			
	That's what we did last week too. Looked at the new book, because we have a new math series, to see what 2nd and 3rd, how much fractions there are in there… We found out very little.					There was very little?
	Yeah. Especially for 2nd, jumping to what you guys (3rd grade teachers) have.	And then we alesson studyo considered, do we want to do […] an introduction to fractions for the year or have the kids introduced somewhat to the fractions before we did all this…				
	I thought that we saw on the schedule for 3rd grade that… didn't we see a tentative date to do this? It was right in the middle of..					
10:00			Beginning of January, but we can do… try to work some things before…			So this is an introduction.
		But there were 3 lessons…				Right but the 3 lessons comprised the introduction so that the 1st lesson is the very introduction of them understanding what the whole is and then be able to discover themselves…
				I like that a lot.		
11:00						So if you got a chance to do the on-line [describing it]. But the thing that was so powerful about it is that they understood that it had to be equal parts. But what was hard for them is folding it first in half. They went immediately to eyeballing it. Which wasn't bad either. It showed a lot of what they knew. Their conversations showed that they knew a lot about fractions. So these kids hadn't done anything subsequently.
12:00						
13:00						
14:00					So once again, I pulled out the pacing guide, and it's January 11th through the 27th, is when we're suppose to do fractions.	So, you're still back at what lesson you want to do?
15:00				Yeah. That's what we're kind of stuck on.		
16:00 17:00 18:00	Reading the manual. Asking Bonnie questions as they're reading. The teachers are confused about using a meter, which is a new measurement for the kids.					

19:00						Well, the thing you want to be thinking about, depending on the task you pick, you might not want to give them a meter… you might want to have a representation of a meter. Or whatever you decide the unit is.
20:00	I don't understand what we're doing… Are we not going with this one?				I don't know what we're doing either…	
21:00						I think it would be a good idea if you guys decide what you're doing…
	What we're doing for our actual [lesson]…					I think you were just reading this so you were thinking about your lesson and thinking what ideas might come up from it.
			So we're looking at sub unit 1, how to express the fractional parts?	This [what they're reading] is the exact thing we saw [in the video], right? Talking about the students' thinking and misconceptions in the video.		
22:00		Do we want to start by showing them a strip that is not exactly a meter that can be divided equally to halves or thirds to get them thinking that this little strip here is what part of the meter strip? And then we'll have them do one that is over a meter long and they have to struggle to figure out that it's the meter plus this part.		Doesn't understand.	I understand exactly what you're saying.	
23:00		like, have them practice a little bit of fractions in the beginning by giving them a short strip that's not even… so it's less than a meter […].		Oh, ok.		
		But I don't even know if that's going to meet any of our goalesson study…				I'm wondering why you want to start with something less than a whole, before you present the whole. Because that's something that they know - the whole.
					Right, so you're saying we give them, let's say hypothetically, 1/5 strips and the whole so they would see that 5 of these 1/5 strips make up the whole?	
24:00		Well, just to establish that it all has to be equal parts. And this is 1 of 5 to make the whole. I feel like it's good to do some kind of review, unless we're going to do a pilot during the lesson.				Guiding.
25:00					I think, from what you're saying, more than half of the class, their minds will be blown if we start with the strip that is greater than 1 unit. I think it would be pretty hard to grasp.	
			Yeah.		I can see they're not getting it… throughout the whole lesson. Because, again, the way that they see fractions as part of a whole, it makes fractions kind of difficult for them, or fractions greater than 1.	

				But they're really just looking at that piece. So it becomes its own little fraction. Will they be able to separate it out like that?	But aren't they looking, don't they have a meter strip too? So they're comparing it against the unit? So I think if we gave them 1 and 1/5, without introducing them to the smaller unit, that they would have a hard time… I just think it would be very difficult...	
26:00		If we just tell them off the bat that this is a meter but there's an extra piece. So it would be a meter and what elesson studye? And they would just focus on that little piece. Maybe that can help them clear up that..	It could be kind of guiding them to it if they need it once they're actually doing it? Because they could come up with some interesting ideas.			Well, in the lesson, aren't they taking the little piece and looking at the whole meter? It seems to me that it's the same.
27:00				Didn't they have… thirds?		Well, you can go back and look at the lesson. He basically took it… he made it his own, but it's this [pointing at the teacher's guide that they were reading]. It's sort of verbatim, this lesson, I wanted you guys to have that as well as seeing what he did.
	So if we come up with something elesson studye, should we write up something like this [teacher's guide].					You'll want to write a lesson plan.
	Right. But it would be…				Right. That's what we did last time. Maybe not quite so…	I don't think it has to be so in depth but you'll want one that looks like this front part.
28:00	So this was how to express fractional parts, the size of fractions [reading the teacher's guide].				If I remember correctly, we wrote a scripted lesson, too.	
	When they say here 3 periods or 4 periods [reading the teacher's guide], they're talking about the size of fractions, they're talking about 3 hours worth of this stuff, right?					About 3 lessons, yeah.
29:00		In this book [students' textbook] they start out by giving them a short piece…				They're comparing the extra piece.
					But check it out [showing the textbook], they're doing everything linear in here. Look how cute. [reads an example. Everyone laughs].	
30:00			That's awesome, actually, that's a really good way to look at the word decomposition.		So the kids are pretty familiar with looking at stuff that are linear.	So what might afford the children if they had a linear, a conceptual linear modelesson study?
		It's another way of looking at fractions.			It's consistent.	
	Does it have anything to do with pizzas?					Well, it reinforces that it's on a number line. And that's what was really powerful about the…

31:00		Do they module on the number line too?				The very end of the lesson the teacher chose to put up, the last problem, she put up, have the meter without anything and have it become like a number line, you know, like he does at the end of the 3rd lesson? She chose to do that at the end of her 1st lesson. Which she didn't have all of the parts, because she didn't do as many parts, but, in her case, she wanted to make that link in the 1st lesson to the number line. So she made that decision, the group made that decision.
32:00		Clarification question - instructional strategies.				No, the kids came to the board - explaining. Instructional strategies and student thinking.
33:00	It is interesting to teach them what exists between 0 to 1.					
34:00					Instructional strategies and student thinking - derailing from the subject.	
35:00						But this makes it visible for them.
				Instructional strategies - derailing from the subject..		But it still sounds like you guys are trying to decide what you want to do in this lesson.
				We are…		
	What page was the one we start…					
36:00	We liked stuff but if we were going to do it in 3rd grade, it should be one that benefits the 3rd grade.			We should look at student difficulty and see if that matches our students.		That's a good idea.
				Referring the group to the teacher's guide.		
		Well, this part here [pointing to the guide] is basically what we were talking about where we wanted them to see that the greater the denominator, the smaller the size of the fractions. And that could mean… if they cut it into different fractional parts and compare them against each other...				
37:00				It would be nice to give them something to solve that's…		
		Maybe we should do that. It seems like most of us like that idea. Having them figure out what that unsolved piece is.			M-hm. From the on-set.	
		So that would be one of the tasks then…			It would be the last one.	
38:00			Does the sequence matter that much?			No. What do you mean?
39:00			Because they don't really build on each other…			These are just ideas so an idea subsumes that they know […] but you'll have to make that explicit. So they're kind of in order in here [the teacher's guide] but they're not… you don't have to say to the child […], it's not that kind of order.
40:00				Pointing to an activity she likes in the teacher's guide.	Oh, we were talking about that too. Yeah.	You guys did that problem with the strip? How did you find that?
				We all did it differently. Some of us were more similar but some of us were really different.		So that's kind of what you're asking the kids to do, right? And you might find the same thing. That they have…

41:00						So, Emma, is it going to be in your classroom? So how do you feel about that in terms of where your kids are…
			My group… they're pretty high skilled for the most part.			And for yourselves, is it kind of a research question that you're interested in?
	What is actually the research question then?					That's what you have to decide…
	But give me an example of a research question.					Well, a research question might be: can students find the whole if they have a part? Do students understand how to partition? Do students understand a unit? Do they understand that the smaller the denominator the bigger the fractional piece? Any of those can be…
42:00	Well, I think we all… well, some of us like different things, but I think we're kind of referring to the 3rd grade teachers, what's appropriate for the 3rd grade? What's the most beneficial?			Last year, my 4th grader had trouble understanding a whole unit. They think they know it but they don't know it. The whole idea of 1 as a whole was hard.		
43:00	So would you think that's an issue of knowing what the whole is or the meaning of the denominator?			That's a hard one too and then comparing them. But if you give them a number line, like some of the test questions last year what would just throw them was when it had a mark, one of the fractions had a mark and they were supposed to say what that number was. And they were given choices and that was hard for them. So I think these are really appropriate if 4th graders are having trouble with it then 3rd graders…		
44:00	So then the partition of the fractions is something that would be very beneficial, ha? [Reading from the teacher's guide]. The number line… they make it easy to see that the same point can be described by different fractions.					Again, these are all things that are subsumed in that one lesson. So you wouldn't necessarily have to do one lesson on…
45:00			What if we watched the tapes, see if they are talking about these things…			Yeah. I mean to do the task successfully. By the end, they became more comfortable with it. But they knew a lot going in. it revealed what they knew. Even though, like the 3rd graders, they didn't have anything on fractions…
46:00		Maybe it becomes daunting to them when they see a problem that they've never been exposed to but they probably know…				Well, there are a lot of misconceptions that kids have [pointing to the teacher's guide]. This is what's clear. And you're right, part of it is exposure. If they've never had an exposure to a linear.. They just see it as a piece of pizza… it's hard. Because you cut it out and paste it. they might have some intuition, but if nobody helped them make that connection, at least in the US it seems to be a big problem.
					Well, the signs that he had showing the distances with fractions..	

47:00				Then we're back to thinking about this one [showing the textbook], the arms spend. It's nice.		He really started with those lessons. He just had the power point slides, if you'd like I can see if I can get them for you.
				I kind of like the 7 meter long strip.		That came out of the students' questions.
		Well, the thing is, if he used any kid, and that little piece has to fit exactly into a fraction that's not too difficult. You don't want 1/17…		We have to do it to one of us. So we can know already what it is.		
48:00		So we should use the arm spend? Is that what I'm hearing?		We are so wishi-washy…		I think the thing is you just need to decide if you're going to start with this introductory lesson or to do something elesson studye you wanted to go to.
			I think we should start with the introductory lesson because we are at the introductory point for these students and they need an introduction. This gives them a lot of ways to express their thinking. And it fits into our curriculum too. And we have the magic fraction line [pointing to a tool on the table].			
49:00		Familiarizing herself with the tool. Andrea is showing her.			Explaining to her. So it's kind of introduction to equivalent… getting fractions on the same line.	
50:00		Playing with the tool.		Instructional strategies.		
		You get to add fractions. Make a whole.			You got it.	
51:00				So we want to do the introductory lesson.		
	Introductory meaning what he did or what this book is saying?	I think we should just do the teacher's arm spend.				
	I don't get it. What is our point then?	They have to figure out what the little piece is.				
	So we're going with what he's doing.			Trying to use fractions to express the size of a part smaller than a measurement unit.		
52:00	So what's our introductory? That? Asking them… [Other teacher's are joking around and Nichole looks frustrated].				Yeah.	
53:00				So according to this [the teacher's guide] our goal is to try to use fractions to express the size of a part smaller than a measurement unit. So we can put whatever we want and think about what kind of materialesson study we want to use…		
		Nichole, it sounds like you want to do something different.				
	No, it seems like we're doing a lot of talking just to come back and do this [pointing to the teacher's guide]. So we're doing what he did? Same lesson?			Sounds like it. Unless we'll come up with something elesson studye. I think we've agreed on anything elesson studye other than this one.		
54:00	Why?			I don't know.	Because it's the easiest thing to do. And it's the most compelling.	
				I still like the '2/3 - show me a whole' …		
		We can do that in the beginning…		But then I'm just stirring the pot…	So… give us the quick and dirty about 2/3 - show me a whole.	
				Well, if this is 2/3 [picking up the textbook as a length measure] - how big is the whole? So they have to find the piece that makes it whole. [explaining]. So it's tricky but it might be…		

55:00		But that would be good to see if they… You're predicting that they…				I can imagine you including something like this if you have time in the lesson, I still think you need to start with what a whole is. Especially if they haven't had an introduction.
				Exactly. Otherwise they're like 'what do you mean?'.		But you [Andrea] could try that in your class.
	Well, this doesn't start with what is a whole.					Yes it does.
		It's starts with the whole and a little bit…			Showing the textbook and reading. I love that guy!	
56:00			Yeah, but they already have decimalesson study so that's a more logical way to start.		Let's think about how to express fractional parts …	Well, that's a question that they came to since they already had decimalesson study, if the kids haven't had decimalesson study. that's not a question that they're likely to have. Giving examples of students' anticipated responses. But if you're going to choose to use this lesson, you can't let them go on forever with the activity, you need to figure out how you're going to play it out. Then you give them the meter and the piece and they have to figure it out.
57:00				I think it's a great lesson. I think it would be fun to do…		
			It gives a bit of room to talk about ideas about fractions. It's pretty open ended and we can use all sorts of fraction knowledge to solve it so…			And you can certainly put a touch up on these things. If you like one more than another you can wrap it up in a different way or…
58:00						So how long do you think your lesson will be?
			45 minutes…			So that's another piece that you need to think about. And how many kids do you have?
			24			So what sizes groups… So this week you're going to try for the lesson?
				Once you decide on an idea it's not so hard anymore…		
59:00	What I don't understand is this [the manual] says that it's 3 lessons to do this part…					

Video 8B

	Nichole (20)	Sheryl (11)	Emma (6)	Andrea (3)	Josh (2)	Bonnie
0:00	I don't understand how we're going to do the whole thing in 45 minutes…					Well, you saw the lessons on the videotape. So that first day, he covered quite a bit. And that's the first lesson, that's what you'd be talking about.
			Maybe we should look at it again.			Yeah, I would urge you to look at it again. And you're correct in that they spend much more time on much fewer concepts.
	They spend 4 40 minutes lessons on just the size of the fractions.					Yes.
	But we're going to take this whole thing and do it in 45 minutes?					No.
				No, we're just going to be doing a portion of this one in 45 minutes. Probably not even the whole thing… as far as what we are studying… as far as the lesson study.		

1:00	So we're just doing…					So this one, for example, it says 'how to express fractions…' giving example of what another group did.
2:00						I think it might be useful if you went back and looked at that first video, it's just a short clip of it, but you get an idea of what happens through the lesson.
3:00						I think the trick is thinking about what fractions you want to show, how long it's going to take to… that's why I think it would be really good for you to figure out what materialesson study you want, actually do it with each other to see how long it takes you guys to do it.
			So should we try to review the video before next week or would that be the first part of the meeting?			
4:00 5:00 6:00 7:00 8:00 9:00 10:00 11:00 12:00 13:00	Scheduling and logistics. Bonnie's leading and guiding.					
14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00 24:00 25:00 26:00 27:00	Reflections.					

Video 9A

Deciding on goalesson study for the lesson

	Nichole (20)	Sheryl (11)	Emma (6)	Andrea (3)	Josh (2)
0:00	[Reading something and connecting to fractions in the US:] The say although we have a lot of resources in the US, they're targeting this, that they feel this is somewhat neglected. And that the main thing is linear measurement content. See I'm starting to get into this! So anything we decide to do, we need to put in that context. And that there are 5 sections of this but afterwards, we've never gone beyond path A, have we? Because it says later there are steps to identify activities they suggest in section 4. But we've never got to section 4, have we?				
1:00	Do you see all these arrows here [pointing to the teacher's guide]? Those are suggested activities. I don't know if that's helpful, then I got interrupted…	We kind of discussed some of these things… but I'm thinking back to when we did lesson study a few years ago and we had our arching goal that we started with [to Emma]? So do we want to go back and do that first?			

2:00	Well, we can do whatever we want and we have to sort of teach it with a linear measurement. So it doesn't matter if we look for greater / less than fractions / equivalent fractions… we just need to put whatever we teach…	But the way we teach… if we have wholes then we can have a better sense of how we want to teach it. I don't think we… decided on a content…	I know. We decided and then we kind of took two steps backwards…			
3:00		I'm almost thinking if we have it written down, then we […].	I know, but we just need to write it down. If there's a compelling reason to change our minds then we can still do it.			
	They seem to feel that using a linear method help students develop important insight about fractions. And they keep emphasizing this 6 time on this page… it doesn't matter what we decide to teach we just need to put it in a linear context.	Ok.				
4:00	But the 3rd grade teachers, remember, we were supposed to kind of think about it over the break and then decide what they felt would be the most beneficial? [talking about how her and Emma were suppose to meet to watch the movie together but that didn't happen].		But they go back and do it a second time. So that seems like the real […] to go back and do it a second time with modifying it, so that seems like a really exciting point but we're just doing the one lesson, right?			
5:00		It would be nice to go back and do it again…				
6:00	Talking about the logistics and finance issues of doing it a second time.					
7:00						
8:00	But we need to get going on the… we need a plan… [Reading from the teacher's guide].					
9:00					[Reading:] Ideally, what qualities would you like the students to have 5 years from now? So… should we spend some time feeling this out?	
10:00	Well, this has the template for the planning of the research lesson […], so we're kind of starting big and getting smaller? Do we have a main aim or is that already decided for us by putting whatever we do on fractions on a linear… Isn't that a main aim?				I thought the main aim was for them to have a deeper understanding and a more… I don't know…	
11:00			Understanding fractions as a number…		Yeah.	
			The linear thing is just a tool. a method to get there.			
		Ok, I want my students to be critical thinkers [filling out the template].				
	Don't you have to come up with what that looks like?		Them being able to have conversations about the math work that they're doing and […] what they're choosing is appropriate? Because right now I think my students are pretty good with the numerical calculations, like if they know what the formula is, they're fine with doing it, but they don't really go beyond that to make sure they really solved it properly. They just want to come up with an answer and be told that they're right. without being able to evaluate it and see if it makes sense. So critical thinking would be... evaluating the work, right?			

12:00	And that's what you wish your 3rd graders could do?		Well, by the time they finish 5th grade, yeah. I mean, no, I'd like them to be able to do it now, in 3rd grade too. So a strong but flexible number sense, like being able to apply that to things.		
13:00	So we put down all our ideas? Are you feeling that out to [Sheryl]?				How about using their knowledge of fractions […] without being prompt to, just using it? Thinking of things in fractional parts and fractions as whole numbers… but actually applying them.
14:00	So your idea, you want them to be critical thinkers, and what did you [Emma] say you want to use?		Be able to use critical thinking, apply their math skillesson study, and evaluate whether they use them appropriately. I don't know if evaluate is the right word…		
	And you [Josh] said you want them to know that the whole…				I want them to use what they learned in their lives, their everyday lives. Studies…the mastery of it.
15:00			Is evaluating a validity of their solutions? They're just throwing out answers and just want you to say 'yeah, you're right', instead of checking to see if it's reasonable…		Connecting what Emma said to a 3rd grade standard. Reading it.
16:00		How about working as a teem and being able to work as a team. Because when you when you're going to the work force…			
17:00					
18:00			So for my group of kids, they're pretty good with their calculations and they cooperate pretty good in a group setting but they don't really evaluate their work so that would be good. And if they were able to do that in a group that would really be amazing, if they could respectfully talk about ways ...		
	I find that the 2nd grade, which is a lot like the 1st grade, just going in a little bit deeper, and going for the number sense and counting on their fingers… it's doing the same stuff but kind of in a different way, I'm finding… I don't know, it became clear not long ago that these problems here, if everybody can do them, that's average. If you want the top grade you have to do the... it's not just critical thinking, it's taking the information that everybody is able to do and applying in in a different setting.				Reading another standard that has to do with generalization.

19:00	But it's not just a different circumstance, it's just… if they put the same problem in words instead of numbers. And they just make it more compound. And I'm really trying to get the kids to learn that, because you're not going to be the top student if you're not able to do that, and I think they are starting to see that and now they're at least trying. Because if the district tellesson study us to skip the problem... but unless you can do that you can never be an A student. Never. and we just assume that they are... kind of. I would really like them to start doing that [...].				
20:00					
21:00			Talking about an exercise in the video they watched - instructional strategies.		
22:00					
23:00	Instructional strategies.				
24:00	I love math. I feel like they're kind of wrecking math… in the old days… there's something satisfying about doing problems, there's nothing different between that and a puzzle […]. There's something about it that is peaceful. And it is a final product [...]. And I feel like they went with this thing, we're right, well, why is that? And yeah, maybe if you can talk like that or write like that, it makes you on a higher level of math, but by making everyone do that, it's pointless...				
25:00					I like that aspect of math where you're doing word problems or challenging them to puzzles that aren't just algorithms or equations, like using words and applying what they know…
	If there's some math you can do without knowing why you're doing it, once you've mastered it, then the understanding can come, and I feel like a lot of the times they want to understand it first and it doesn't work like that for some kids. I mean, we move so fast, they don't get what they need. That there's nothing wrong... if I got a kid sent to you in 3rd grade that knew all the multiplication but didn't understand what it meant, wouldn't that be easier to work with than someone who kind of understood it but couldn't do it?				

26:00		I'd actually want, if the students don't understand that they kind of seek to understand why… […]. When I was learning math growing up, as long as I couldn't understand the reason behind something, I couldn't remember it. I would struggle with memorizing... well, I wouldn't say memorizing but as soon as you understand why this is the correct way to get to the answer, it's so much easier for you...			
27:00			Yeah, it makes it easier. And alesson studyo about the thinking, if it's just easy to do math because it's fun and it's easy […] and then they actually hit a wall when it's challenging… you know, kids that assume that they know stuff and that it's going to be easy, and then they get something that's not easy, then they just give up. They're thinking 'oh, I'm not really good at math'.		
28:00		If it's been easy for them all along, once the challenge comes up they might even be motivated to work harder…	Because they love being right and correct all the time, they're kind of ignoring the part of the critical thinking already and the problem solving […]. But at some point if they really want to pursue math they're going to want to be able to…		
29:00	Don't know how realistic it is to think that we're going to have all our kids at 6 or 7 to be critical thinkers and cover every area because we are touching on every single math concept for 3 or 4 days each… But if we did want to do that […].				
30:00			This is really nice [looking at the teacher's guide]. Did you read their goalesson study? [Reading].		
31:00		Reading goalesson study from the book.			
32:00	Do you want it to be curious?				They were all curious when they were learning how to talk…
	Well… some are, some aren't…		You have to have that curiosity […] that motivation…		
	So if we could come up with our goalesson study, that would help us out…				
33:00		Reading goalesson study from the book. Goalesson study for our subject area…			
	Ok, so our subject area is fractions, right?	Actually, some of the ideas that we mentioned actually belong in this category, and then goalesson study for the lesson… we've talked about goalesson study for the lesson…			
	But we can't do all that… We have to pick one.	Well, maybe we can start with one and then maybe incorporate the others to the lesson?			
34:00	Where are all the quotes?				Section 3, starts at page 33 with the type of understanding or knowledge next to […].
35:00		Ok, do you want to start with just one then?			

	There's something about keeping it simple, I've learned that we are always trying to pack too much into a single lesson.		Wants one of the goalesson study to be writing a journal.		
36:00	And we can do that because they're used to it? Doing math and then going to write in a journal? Are we adding a new thing that we need to teach them how to do?		Yeah, they haven't been writing… They've been writing sort of a journal… less structured for their science journalesson study […] so they are familiar with it.		
37:00	So that may be a goal of journal writing. But we might need to have a thing in the lesson where they explain it to another person. If they can do that, then they can go write it down.	We don't have time for that, we just see what they wrote in their journalesson study.	Yeah, it'll be a way for us to check their understanding.		
	But if it was you [Sheryl] or me, and we were going to do that in a month, we need to teach them how to do that. Because they wouldn't know how to go and write math in a journal. So if yours aren't doing it, it adds a whole other element of a whole bunch of kids won't be successful.	It would be interesting to see though, because this is 1st grade, they're just learning how to copy of the board. By 3rd grade, they should know to copy if they don't know what elesson studye to do.	Yeah. So I have a group that is able to copy ideas to get them started […].		
38:00	But then it becomes not a thing about fractions, it becomes a thing of 'let's shorten the math part so we can accommodate the kids that are copying of the board… Do you understand what I'm saying?	But it's so simple, you're doing the fractions on the number line. Just draw the number line, mark the points where the whole, and then have them write the fractions… can they even do that?			
39:00	I know, but there's still so much that the kids who can't do are not learning anything, just… copying… it just seems like it takes them away from the math and ends up being language arts lesson.	But there will be a time for them to explore in their seats.			
	Because I think in the video, one of the reasons he was so successful was because the kids were thinking about math and being able to articulate about math, it wasn't like, ok, now go write about it.		…asking about their comments and responding about them…		They had to write about it.
40:00	Well, that was when they could get him direct feedback. Well, ok. I'll go with you guys.	Was there something elesson studye you wanted to…			
	No. I don't know what we're doing… I find it hard to have the goalesson study until I kind of know the… it's like I work from…				Well, what's the last type goal for the lesson?
	We only have one goal for the subject area so far…	No, we do. We do. We have discussing solutions respectfully. I mean that's for the lesson itself, no? what about applying knowledge of fractions to other situations?			
41:00	Ok.		I'm just wondering if this [pointing to the textbook] is too hard for a first lesson of fractions...		
	Just know that if I'm teaching your kids, I'm telling them that I didn't pick the lesson… [laughing].				

42:00					I was thinking, going from this [pointing to the textbook], if we use this as our lesson, then the lesson goal would be 'when students are measuring an object that is longer than […]. Wasn't this something we sort of weighed back when we were first doing this? What we all enjoyed about the lesson ourselves is something we wanted them to do so make that our nice simple easy clean lesson goal? let's do that?
43:00			Yeah.		It seems that it's using some of the background knowledge and it seems to be the whole deal with this lesson, right?
44:00					
45:00					
46:00					Ok, so we'll write those things down and make it happen.
	Reading out load what they've decided on.				
47:00			So, we make that happen. Should we watch the video again before we meet?		
	Watch the video or [raising up the teacher's guide] is that what he was doing? Are we still going with this?	I can't do it on my own, we'll have to watch it together…			
	You can't watch the video on your own? Why?	I forget..			
48:00					
49:00					
50:00					
51:00					
52:00					
53:00					Reading the goalesson study and objectives of the teacher's guide for the video they're going to watch.
54:00					
55:00					
56:00					
57:00					
58:00					
59:00					
60:00					
61:00					

Reflections.

Video 9B

Reflection writing.

Video 10A

Planning the lesson study

	Nichole (20)	Sheryl (11)	Emma (6)	Andrea (3)	Josh (2)
0:00					
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37:00					

Talking about the logistics of giving the lesson.

38:00				Ok, we have 20 more minutes, what do you want to do?	
		We can start writing up the lesson. When do we need Bonnie to come in?			
	Does she watch the actual lesson?	Yeah.		Oh, I didn't know that.	Yeah.
39:00					So, what do we do now?
40:00					So, maybe we should go over what the lesson is? Or… I think we should start the lesson sequence.
				Yeah. That's a good idea. If I remember correctly we were thinking of doing the very first part of it.	Yeah.
				How to express fractional parts…	
41:00	[Reading:] Is there a long term goal for student development? What's our long term goal?	So, I hope you don't mind, but I organized… [Handing out a typed sheet she made]. I figured if it's typed… we'd stop asking the same questions… We can change it…			
	Well, it says after the long term goalesson study you need the standards. You didn't put the standards on here…	We can talk about that now.		So, 3rd grade, do you guys [Josh and Emma] have 3rd grade standards?	Yes, I have them right here.
42:00					
43:00					Reading the standards.
44:00	Ok, so next - plan. [reading]. Select a revisory lesson. So, we write it up? It's been a long time since I've written a lesson plan…			Reading from the teacher's guide. So we were thinking of doing something like the lesson here only the first part of it. Remember about the meter and the part? So that's where we left off. We have to make it our own, and these guys here make it a 1 and 1/3 meter length tape, one per student... [reading] - so that's their key question.	
45:00		Do we want to start with an introduction first?		Yeah.	
	[To Richard:] Didn't you have an idea that you mentioned a few weeks ago?			The little kid? Different size arms?	
46:00	Yeah, I had the meter stick that wasn't really a meter…	But then we decided we didn't need a meter… we would just tell them 'this is a meter'. So we have 1 strip that's a meter strip.			
	Are they going to cut... What are we going to cut and what are they going to use?		We have a bunch of fraction bars…		No.
	But they have numbers on them, right?				[To Emma:] Don't you have receipt tape?
			Oh, yeah!		
47:00					[To Andrea:] Where are you, front page?
				Tellesson study him what she's reading. And they have key questions here. I like the key questions. [everybody's opening the teacher's guide]. [Reading:] that's exactly what we want them to do, isn't it? It's a good introduction. The tape is fine but we kind of have to get them thinking in terms of [...].	
48:00		Maybe real-life situations where they have to deal with fractions.	We could show slides of road signs?	Oh, yeah!	

		And did he ask them what they meant?			
49:00			What about a meter jump?	What is that…?	Actually, that is a good one. We've already done this.
			We had them jump meters, like, here's a meter, see if you can jump over it… Just to get used to the length.		
		And have them jump half a meter… [laughing].	Or more… so you can jump a little bit more than a meter.	And how much is that?	Or we could alesson studyo do… I recently bought a chalk line so we can draw half a meter, a meter, a meter and a half… And they can actually jump it.
50:00	Are we going to use the same numbers? A meter and a 1/3?				Yeah but they would not have been introduced to fractions actually.
		I was thinking more about activating prior knowledge along the lines of fractions so if you're jumping a meter, it's the whole thing…			
	Well, that's the dilemma that comes in with it, you have a whole that before you were trying to say over or equal or under a meter, and all of a sudden somebody jumps here. How do you determine if, instead of 'over a meter', how would you know the exact amount?				
51:00			So rather than accessing their prior knowledge of fractions, we're accessing the whole knowledge and extending it with fractions.	I like that. Because they'll all remember it because it will probably be fun for them.	
52:00					
53:00		Ok, so that leaves the task that they have to do to find out what that little bit is. We'll bring out the strips…	We can make up strips that are the pre-determined length, maybe even mark it out, say you have your chalk line that shows 1 meter, 2 meters, and then put a mark there and say 'ok, who can jump this far?' and have strips that are the same distance you just jumped. so giving each group a strip that's the length of that jump, and they have to find how far was the jump.		
54:00					With just pen and pencil… and your brains…
				So they're not going to do the jumping game? We're just revisiting the jumps they've already done? So we'd need 20 strips?	Well, do we want one per student or do we want to group them up?
55:00		Well, we want them to be team players so…		So pairs or teams?	
			Probably teams. 3-4…		
	If it was my class there are 1 or 2 that would, you'd need to have the support as far as their curriculum.				
56:00		Assessing the time for each activity.			
	Are you going to decide the groups ahead of time?		Yeah.		
			But I want groups of 3 though…		
	And if someone needs assistance you can do a group of 4.		How about groups of 4 and 1 group of 3? So 6 groups.		
57:00		Assessing/planning the time for each activity.		Assessing/planning the time for each activity.	For logistics we need an early finishers activity.
	What do we hope that their answer would be? 1 and a 1/3 meter? Or are we asking them how much it is over a meter?				

58:00				I think what was interesting in the lesson is that it was exactly 1/3 and they could fit the piece into the meter… but they might think it's 4 because there are 4 pieces… We don't have to do a 1/3…	
	Well, that's what I'm saying, are we giving them that [showing 1/3 with her hands] to figure out or that [showing a meter]? A 1 and a 1/3 to figure out?				A 1 and a 1/3.
			Yeah, and then they have to figure out what that piece is.		
	How will they know there's a piece left over if it's not mark a meter?				There's going to be another one that's a meter. So this is one meter, so what's this?
59:00	What do we want them to answer?				1 and a 1/3.
	And you're saying your students would know how to do it yet? [they're answering around but not answering the question].				
60:00		I think she's trying to ask, is there a way we want to scaffold the lesson so that it'll drive them towards that direction maybe?			
	How do we expect them to come up with an answer if they don't know fractions?			Well, we're going to tell them it's like an introduction to fractions. But it shows them…	

Video 10B

	Nichole (20)	Sheryl (11)	Emma (6)	Andrea (3)	Josh (2)
0:00				…just a part of the whole thing. Because they'll be looking for that little part. So that's what gets them thinking about fractions. It says here [reading from the teacher's guide] …so the unit is important. But then we have to… it even says here something about [reading] so later on in the lesson you can actually start bringing in some more elements of what is a fraction.	
	I think that is a lot in one lesson for somebody who did not do fractions…	went over the time…			
1:00					
2:00					
3:00					
4:00	Reflections.				
5:00					
6:00					
7:00					
8:00					
9:00					
10:00					

Video 11

Planning the lesson study

	Nichole (20)	Sheryl (11)	Emma (6)	Andrea (3)	Josh (2)
0:00		Giving them typed papers that she prepared.			
1:00		Going over the rules and roles.			
2:00		Talking about the logistics of the substitute teachers on the day of the lesson.			
3:00					
4:00					
5:00		I think the main focus for today is to write down the lesson.		I can do that while we choose who's teaching…	
	Why don't we vote?				No, no no… that's not how it works…
6:00	Maybe somebody wants to do it…				You can do it…

		We should write the lesson first…			
7:00					
8:00				So I wanted to start by connecting our lesson to the meter jump.	
		Oh, we alesson studyo have to decide what each of us is going to observe.			
9:00				So, there's this thing here that's called teaching and observing the research lesson. Do you think that can help us?	
10:00			Reading out load.	Reading out load.	
11:00	Reading out load.				
12:00		Reading out load.			
13:00					
14:00	I think we should focus on the lesson instead of talking about who should be in the room…	I think we should read through this in case there's some relevant information…			
	Our time will run out and he haven't done the lesson…			Why don't we just read this silently to ourselves so it takes less time.	
15:00	Reading.				
16:00		I think Bonnie is coming for the lesson, should she join us for the post lesson discussion?		If she'd like to, I don't know if we are suppose to be the ones doing it so if she wants to be here, that'll be great.	
				Do you guys want to jump onto the lesson?	
	Look at the next page. Is that what we're suppose to be filling out for this day? Oh, yeah, here, lesson design.				
17:00	You know, I was looking at the specific goalesson study… They have to know a little bit…				
18:00	So what do we do first? [Looking at Sheryl].	I think… didn't we say we want them to do […] the activity? And I was thinking maybe we can figure out which one of these goalesson study […].		Yeah, these are a lot of goalesson study, I don't think we're going to have time for all these goalesson study, but I like having them written out. To choose which ones are we going for.	
		At least, if it's not covered by the lesson, at least we can do it in the previous lesson.			So, should we have the [teacher's guide] opened up side by side with this [the manual]?
				Yeah, I think so.	
19:00	Flipping pages back and forth, looking confused, and unable to focus and start writing, reading the teacher's guide.				
20:00	You know, on this other thing, this more informal one [the manual], it says goalesson study, but it's kind of like what's our main aim?				
21:00	So we're just doing the one then, our goal is to find the length… Is that what we're using? 1-1/3?			Yeah, how to express fractional parts?	
	Are we trying to figure then how to do the fractional part or actually solve the problem?			We were thinking we're probably only do the sub unit 1, is that right? So then it's an exploratory lesson so the biggest part of time is them trying to figure it out. And then, I don't know if we'll be able to go into another part. It kind of looks like that might do it but I'm not sure…	
22:00		Well, that's what we were agreeing to. But I'm kind of concerned about… She [Emma] has to prep them, right? They probably forgot some of the things…		Are you going into fractions yet?	
			That's my question… […]. I can kind of customize it.		
	And she does have to do it because for the 2nd grade knowledge, there's nothing in the 2nd grade curriculum that would solve this whatsoever…				

23:00	But we're talking about 1 day and what, 45 minutes? And, I don't know, if it gets to setting it up with the jumping meters and exploring this and alesson studyo summing it up, what did they learn from it, journaling … can it all be done in 40 minutes?			I think that's all you can do… yeah, I think that's it. But the journalesson study thing, cause they don't have math journalesson study, are we just going to have them write it in their math notebooks?	
		This is our chance to give them more time than usual, time to do math.		Yeah, that'd be great! I like that. You mean for one idea, just exploring it. Yeah, I like that idea.	
24:00			Should I teach them about fractions beforehand and this study is more of a chance for them to do more of the exploratory aspects and kind of apply what they know? More than it being an introduction…?		
	Yeah, I don't think this can be an introduction to fractions.			Well… I don't know. I mean they have information about fractions already.	
	Coming from 2nd grade they've never worked numerically… We don't do any of that. Especially with this new program…				
25:00				And then by 4th grade they're [listing the things they do]. It's huge jumps…	
	I feel like just to take the number and eventually, adding ,subtracting, multiplying, and division, it doesn't have anything to do with teaching them what does 1-1/4 actually mean […]. It has nothing to do with knowledge of what this represents…				
26:00			So should I focus my teaching on a linear scale?		
	Yeah, somehow I feel like they really need to get that concept right here, that 1N fits exactly N times into the whole.				I would say you should teach it like you would normally but the linear steps would be more exploded…
				Yeah, I don't think you should teach to this lesson. Just introduce fractions. Because otherwise, they've gotten it in some ways, you know? And this is their trying to explore and understand. I mean, they're dealing with the concept of fractions so it seems like you should at least start it, but not go through the whole thing. Don't you think?	
27:00					What's interesting is if you look at this [the teacher's guide], it's written as if it's being introduced.
	Where did you feel like this just landed itself that they're just getting into it because they will try to use fractions…				
28:00					If you look at page […], it says 'instructor's is showing them how to read right 1/3 […]. So it seems like […] it's more of an introduction.
			So, make sure I cover this part [showing in the teacher's guide] and then in the lesson, we do that?		That sound's cool with me.
			Otherwise we get to spend all day on one thing…		

	So what would this lesson be, would then a kid be able to write 1-1/3? Or take the 1-1/3 and know that 'ok, if that equalesson study a whole thing then I can use that to figure out what's this extra piece is. That seems like a leap…				
29:00	Because a lot of my kids would be stuck on trying to learn to identify what's 1-1/3, 1-1/4 means…			And they're working in groups. That'll help because there's more than one head thinking about it. And I think they'll understand the leftover idea. And then, if they don't solve it, it's ok. It's not about them solving the whole problem, but more of exploring the whole concept.	
30:00	So then our goal is… so how would you identify if they explore it well? I thought we were supposed to set some specific goalesson study…			We do have a specific goal but it doesn't mean that the whole class is going to solve it. Remember that lesson, some people solve it, some people didn't, but then you talk about it afterwards and you see the different ways and then you teach it…	
		They'll have to do a post-test too so we'll be able to see how much they've learned.			
	Well then, if there is a test, what would the results be?		Well, then we have our observations to know if this was a useful way to be teaching it, and we'll have our observations about what not to do and what was difficult for them, if it's too easy […].		
31:00		[To Andrea:] Did you say you want to test it out on your kids to see?		Yeah, I'm thinking about it… if I can get my kids to settle down at all… I would really like to try it out on the kids but…	
		This would be good in determining if this is too hard for the 3rd graders…		I have a pretty low 4th grade class… and you [to Emma]…	
			Yeah, they're pretty high.	Some kids can do it like this [fast] in my class cause I have a group of really right kids but then I'll have one that'll be really stuck on it and not understand, and I have kids that I think, my idea is I think some of my kids who maybe can't do mathematical things, they'll be able to do it because you know how some kids can just see things? cause I have a couple of kids that are pretty amazing that way and not very good at other things. so when I think about my group of kids, it's going to be a mixed pack.. but yeah I should try it [...]. And they like fractions so they'll like the lesson.	
32:00		I don't know, I'm just thinking if we're doing this and they're struggling through the lesson […], it seems like more of a test to see what they can and cannot do…			
33:00				I don't see it as a test at all. I see it as an exploration.	And looking at the sequence, it does look like you're taking them through the journey lesson. If we use this sequence or something similar to it, you are really walking the kids through, more than I remembered in the video.

		So are we thinking to do exactly what's in here except changing a few things?			Changing a few things. But I think this is…
34:00			I'm just thinking that the core heart of them writing was when they did the lesson and they were all figuring out different ways of measuring it? […]. We need to make sure we're doing everything before that as a class because otherwise we're going to end up observing…		
35:00	I think that in order to get through the lesson we need to introduce the linear concept beforehand. And I don't know what you do with your kids, I don't do anything linear following the book in 2nd grade, it's all pictures.			Do you use the number line?	
	No. not at all. The old one [curriculum] used to compare the two, now they've cut that out of it. All they're suppose to know is if the denominator matches or equalesson study 1 as a whole.				
36:00		Would it help if the class establishes what a 1/3 of a meter looks like?		Well, when they snip off that little part, they can discover that… and if one kid gets it, the whole class will get it, don't you think?	
	But […] it's distant. It's not… we're doing fractions now and to me […] it feelesson study more like a measurement rather than a unit… feelesson study more like it's tide to the unit that we do in 2nd grade on measuring things […]. It's related to the fraction part of it.				That's why I think we should have a 1/3 set aside but by saying 'look, this is a meter and this is this other distance, and we're trying to figure out what beyond a meter it is, what the full distance of it is, they will have been doing fractions for a week with a little explanation linear fractions and it's…
37:00	That's what I'm saying, they're going to get beforehand a little bit of linear… Because we are measuring… and you keep going with rulers and stuff like that so it becomes more of a…				
38:00					But they're not going to have any rulers, the only things that they're going to have is just this one strip that we're telling them is a meter.
				And that gives them a unit.	
39:00					
40:00	But what do we want to see the kids be able to do? Don't we have something that we want to see and that's our goal?		We want to see them doing what we were doing that time when we were folding, estimating, and trying to solve it in different unusual ways. And then we can see what they've figured out about fractions so far by the way they're manipulating it or talking about it.		
	But when we watched that videotape, the teachers realized that they need to re-design it…		But we're not doing the part about the redesigning because we're only doing the first lesson.		Well, since you're asking about goalesson study, we have a list of goalesson study, we can just circle what we think would be…

41:00	But I thought that when you do a lesson design you do it to see if it was successful so you have to have some measure of what would look successful. If kids are just playing with the strips and doing what we did, you don't really have to prepare much at all because...		Well, we're not going to let them just sit there and through their hand…	Well, they don't have the idea if they don't have the knowledge of fractions… we can figure it out… but look at that [reading]. Isn't that what we're doing?	So [reading] - that's…
42:00	And I think to do that they need to know the second one…	But we're not giving them a fractional part, we're giving them…		And a piece of a fractional part. And they could see if they have 3 of those… backwards thinking…	
43:00	Talking about the goalesson study and it seems that they're not on the same page of what they're going to do - what piece are they going to ask the kids to measure, what pieces of strips they're giving out, etc… They keep repeating the same points and going in circles.				
44:00					
45:00	Scheduling next meeting.				
46:00					

Video 12A

Planning the lesson study

	Nichole (20)	Sheryl (11)	Emma (6)	Andrea (3)	Josh (2)
0:00				Going over everything that they have already done towards the lesson.	
1:00	Discussing logistics.				
2:00					
3:00					
4:00					Josh and Emma(?) met separately to work on the lesson study from the notes from the group meetings. Josh has prepared a document with a rough outline of the lesson with blanks that the group needs to decide on and fill out. He will then make the corrections at home. ...And anything you don't like, or don't understand or have comments about, please don't hesitate to ask. [...] So do you want me to start reading it?
5:00	The group go over the lesson plan, make adjustments and decisions:				
6:00		Terminology / Language		Terminology / Language	Terminology / Language
7:00		Terminology / Language		Terminology / Language	Terminology / Language
8:00					
9:00					
10:00					
11:00					
12:00					Connecting 1st, 2nd, and 4th grade standards for fractions knowledge with 3rd grade standards.
13:00	2nd grade standards for fractions knowledge.	1st grade standards for fractions knowledge.		4th grade standards for fractions knowledge.	
14:00	2nd grade standards for fractions knowledge - But I feel like they put it in 'teacher's standards language'…				
15:00	2nd grade standards for fractions knowledge / Expectation for student learning.			4th grade standards for fractions knowledge.	
16:00	The whole and equal parts we do a lot, and the unit fractions, the rest is kind of a joke… […] I don't know what you guys do when you do that 1 as a fraction. What do you guys do?			Instructional strategies.	
17:00				4th grade standards for fractions knowledge.	4th grade standards for fractions knowledge.
18:00		Standards.		Standards.	Standards.
19:00	Standards.	Standards.		Standards.	Standards.

20:00					Emma has pre-taught this and has set up heterogeneous groups in advance. Will alesson studyo prepare 'group cards' for each group with directions, sentences starters, jobs within the groups, etc.
21:00					
22:00				It's not prompting them into thinking a certain way [the group cards]?	I don't think so.
				That's one thing I don't think we should do.	We'll ask her about the students' cards and have her show it to us.
23:00					Points to notice about the students for the observers of the lesson.
		What we've done in the past is each person choses what he would like to focus on.			
24:00					Anticipated student response and teacher's response.
25:00		Are they used to the process of the recorder [one kid writes down notes]? If it's something new during that day, they might be distracted with that.		Yeah, I don't want the lesson to be about that so much…	I asked her that too and she said they'll be fine.
26:00					
27:00					
28:00		Terminology / Language		Terminology / Language	Terminology / Language
					Our idea… the other thing that we did is we split it up time wise and that is why… we figured [breaks it up to estimated time schedule for each segment].
29:00				What do you guys think about having the students actually write on the board? Or do they demonstrate and we draw it?	
		They have the strips, they can show with the strips.		Do we have something on the board at the end that we're going to show against it?	
		That's what I was thinking last time if we have a pre-made… 1/3s, 1/4s or 1/5s but so they can see that they each have the same length, and put together, makes a meter. We can compare against that to make sure the little strip actually matches.		So we could have a meter strip that is divided into 1/3s already, have the overhanging piece… Like that?	
30:00		No we can compare it to the [bad audio]…		Yeah.	So would that be in the explanation or to scaffold confused groups?
		It could be for that too.		If a group gets off track, what do we do?	If they don't get it? Then, hopefully, when it's explained. When the groups explain it, and then the other thing is how do we choose which groups to explain?
31:00				Can't we hear from all the groups?	Oh, yeah.
32:00				And then I like the idea of having a different size fraction. In a way, we almost want to have a meter separated into 1/5s. Or do you want just the 1/5s and the half hanging on there?	

		When we were figuring the answer ourselves, we were drawing on the strips, I'm not sure what the 3rd graders, the ones that are struggling, what they have… what they're pulling from.			
33:00				That's why groups are good because they can have someone who will be the leader.	Here's where they're drawing from. Here's the first lesson in the unit [showing]. So they've done this. They would have done this [showing the next lesson]. Then it moves on to […] which she will have taught, and then the next lesson is […] where nothing goes beyond 1 whole. So that's what they're building on before the lesson and then the 4th lesson will be the one we're teaching.
34:00				Student thinking.	
		Instructional strategies / student thinking.			
35:00					Materialesson study for the lessons.
36:00		Instructional strategies			
37:00				Instructional strategies	
38:00	Do you know what I figured out why this is difficult for me? Because in our levelesson study, the lower grades, we show them, we teach them, and then they do it. We're not teaching them first. They're kind of tapping what knowledge they have and see if they can figure it out… and that's what's taken me a while to get my head around. I don't usually do that in the 2nd grade. You usually have to show it, teach it, then they go practice it. And they've never actually done this before.				
39:00				It will be their first introduction to fractions so hopefully that'll kind of push them through if it seems like unknown territory. In 4th grade we actually have to start the whole lesson with an unknown question.	
40:00				And they actually think about it in different ways, sometimes if I give them enough room, they actually do things in different ways.	
	Yeah, it's great, but with 1st and 2nd […] they haven't been exposed yet…	Instructional strategies.			
	It's made me want to go back and do more of… play a little more with some of the math…to see if kids…because some people have some math in their heads and as soon as they sort of feel it or envision it, they just run with it and it'd be interesting cause we don't do... everything is so concrete in our level...				
41:00				Yeah, I had some real surprises last week doing some fractions. Students thinking and instructional strategies.	If she [Emma] puts them in heterogeneous groups, there are going to be kids in each groups who are going to get it […] but that doesn't mean that other kids in the group are getting it.

42:00		How do we ensure that the envisioning is passed along, is that what the tasks are for?			That's the intention, now whether it happens, I don't know and I think that's something we can evaluate.
43:00	Well, if you follow along… I mean, chances are they won't get it then they watch that [pointing to the board] and if they never do it again then it's going to be gone but if you follow up they might actually be able to do this.				And I don't think, and maybe I'm wrong about this, but it seemed to me when we were writing this up, and the amount of time we allotted for it and everything, I don't think that it would be a failure if some kids didn't get it. It happens, that's what happens… it's just one lesson…
	Well, no, because some people's learning style is abstract, and some people can get this if you explain it to them…				At the end. Well, they hopefully will.
				Yeah, because it seems like some kids will get it, they'll see it right away, and other ones are going to try things out, hopefully they'll figure it out, and then other kids, we'll put it up on the board, we talk about it and compare and the student can relate to it and start connecting the ideas.	
44:00	The thing is, I understand now why I had trouble getting my head rapped around this, but that's the thing, my complaint was that we had to bring up the same grade math. It's like you want them to get fractions but we spend so little time on it, how do kids ever master this?				I'm surprised, starting the unit, how well my kids understand fractions or figuring it out.
45:00				Same here. My kids are liking fractions. They've been enjoying fractions and I'm like 'wow'. So it works.	
	No, because you're sitting with them actually adding and subtracting and multiplying…			No, we barely add fractions. We're comparing, we're simplifying, we're finding equivalent fractions.	
	But it's still just the number part of it, it's not what a fraction means on a linear… out in the world… It's just a number.			Well, we do it visually. So I don't know… because it seems like we're alesson studyo dealing with the concept.	
46:00		[Playing with the strip] I'm thinking about some of the possible answers that the kids might come up with. I'm feeling like I don't know anything about what might happen.		I think they're going to think it's 1-1/4 because of the 4 parts. So they're probably going to figure that out, how many time that little piece can go in there and will end up having 4 parts.	
		So what are they going to say?		Drawing it and trying to guess student thinking and anticipated responses.	
47:00		So they'll say it's 4/4?			They might say it's 4/4. They might say it's 1 plus 3 because they'll fold the meter strip to 3, and then they'll say it's 1-2-3-4. Yeah…
				And you know you'll have some kids that'll take the long strip and fold it in half, which doesn't make any sense with that little piece, and we'll have to redirect them 'this is the 1 meter measurement'.	Can we color code them? So that the 1 meter is one color and the strips are different?
				Good idea.	
48:00		If we ask them '1 of what?', will they know to say 1 meter?		We might have to teach them that.	They've been introduced to meters […] yeah, they should know. Now, whether they all know and have mastery of this, this is something elesson studye…

49:00				Because they don't really have to deal with… it's just a unit, it doesn't matter what size it is.	
		So we're asking them to tell us how long the strip is? So they basically need to say 1 and 1/3 meter, right? Do they know that exists?		No, I don't think they need to say 1 and 1/3 meter, I think what we're asking them is how big is the piece that hangs over.	No, according to this [the teacher's guide] we're asking them how far they can jump.
				But then we're getting into mixed fractions which…	
50:00	And it wouldn't be that difficult because if they were jumping the meter they know that's a meter and it's over so how much over a meter…	So they should be able to say a meter and a 1/3.		I'll just tell you this because in 4th grade we do mixed fractions and sometimes it's really hard for them to put them together. But because they have this 1 piece, we might have to encourage them.	Showing them a lesson in the textbook.
51:00				Student thinking.	Instructional strategies.
52:00	I think they'll get the 1/3 and they know the meter so it might just be that we have to help them put the 2 together.			Instructional strategies.	
53:00					Terminology / language.
54:00				Instructional strategies.	Instructional strategies.
55:00		Student thinking.			
56:00	Anticipated student responses.			Anticipated student responses.	Anticipated student responses.
57:00	Materialesson study.				

Video 12B

	Nichole (20)	Sheryl (11)	Emma (6)	Andrea (3)	Josh (2)
0:00	Discussing logistics of the materialesson study.				
1:00					Talking about who's going to teach the lesson. I think we should pull sticks.
				Wants to pull sticks too.	
2:00	I just don't feel that being a 2nd grade teacher that I get it… I mean I get it, but it's so foreign to everything that I want to do…				
3:00					Talks about how Sheryl did a really good job teaching a previously taught lesson study and how it's not about how well the lesson was taught but how well it was designed.
		Wants to observe this time because she didn't get to do it last time.			And if you [Nichole] are really adverse to doing it, then we can respect that.
4:00					
5:00				Instructional strategies.	Instructional strategies.
6:00					
7:00		Terminology / Language		Terminology / Language	
8:00					
9:00					
10:00	Reflections.				
11:00					
12:00					
13:00					
14:00					
15:00					
16:00					

Video 13A
Lesson study.

Video 14					
Debriefing after the lesson		(audio problems… very hard to hear)			
	Nichole (20)	Sheryl (11)	Emma (6)	Andrea (3)	Josh (2)
1:00					You can spend all that time planning but during the actual lesson it's really easy to veer off things, make little changes and think on the fly... It happens all the time but when you spend all this time working on it with colleagues…
2:00					Alesson studyo, it's really hard to see what student learning is going on, weather they're getting it or not, if you're pushing them in the right direction (the observers and the cameras were alesson studyo distracting). Alesson studyo, it's easy for me to just talk and talk but this reminds me how important it is to listen to what they're saying and let them make the mistakes. It's consistent across all the groups.
3:00				At first they were afraid to do things and then one kid started folding and they followed.	It was hard to decide how far to go with the paper strips. At first I decided to not tell them to fold it. Looking back I should have told them to manipulate it, tell them all the things they could have done with it.
4:00					Anticipated response
5:00					
6:00					
7:00	Academic language. It seems to me that what kids thought of as a fraction was a number. And they were just trying to get to a number that wasn't necessarily relating to anything elesson studye.				
8:00	student thinking				
9:00	Math language. Somehow it seems that if they had more experience with the language and experience with the measurements, that the two would come together. Because we assume that if you learn fractions, you can measure. But some of them did not know how to measure. measuring is a skill. And we assume kids know how to do that...				
10:00	Some kids didn't even make the tally. And you [Josh] didn't either. You used your finger. So they were coming up with the wrong answer and I think that's really a measuring technique, strategy. And the language felt off. I feel that language would make the connections. I found it extremely interesting.				
11:00			Focused on following directions because we didn't really teach them behavior with the camera and disagreements and stuff.		

12:00			But within the groups, each group had at least one student who did something that we predicted which was the key to solving it but it wasn't necessarily the most outspoken person. So I think maybe with more practice or structure in the group, more kids would listen and think.		
13:00			But there were a lot of actual conversations of how to solve the problem.	Some of the kids just took the role of writing down.	
14:00			As an observer it was hard not to intervene when it felt the students are not making any progress.		
15:00			I alesson studyo wouldn't have notice some things if I was teaching the class.		
16:00					
17:00	Group dynamics sometimes interfere with somebody's style. That's alesson studyo something you teach…				As the person doing the lesson I didn't get to observe. So when I walked around asking students what they are doing and a few answer, I consider that successful but there are still some that don't say anything. Maybe those kids are getting shut out…
18:00	Sometimes one kid came up with an answer that it spread and everyone were giving the same answer. They didn't really know enough about what the number meant to defend their answer. It would be interesting to do the same thing with numbers where they would be more willing to defend or disagree.				
19:00					
20:00		Group dynamics and the interactions between the kids.			
21:00	The teachers are thinking how they could have directed the kids better.				
22:00			Kids' disagreements at the group.	Rules and structure	
23:00		Even if you tell them they can cut the paper strips they afraid to.			
24:00		Group dynamics			
25:00	The students that were actually writing on it were closer.				
26:00 27:00 28:00	student thinking				
29:00					One of the hardest things was to figure out why - student thinking - because that's what I needed to do but I was pressed for time and couldn't figure it out.
30:00		Instructional strategies			Instructional strategies
31:00		Student thinking			
32:00					
33:00					
34:00					
35:00					
36:00					
37:00					
38:00				Student thinking	
39:00	Kids in the back didn't hear the kids in the front… you loose your audience…			Overall I thought the kids were really engaged.	
40:00				Instructional strategies	
41:00					
42:00				They asked really good questions	
43:00					
44:00					

45:00					What alesson studyo interesting is that as a teacher you get angry when students get off task but actually, that 's what they're doing…
46:00					
47:00					

Video 15A

Reading an email from Bonnie of everything that need to be done for this final meeting of the lesson study cycle.
Going over the points for the summary / power point.
Josh has all the copies of the draft to the final lesson study plan.
Writing reflections.

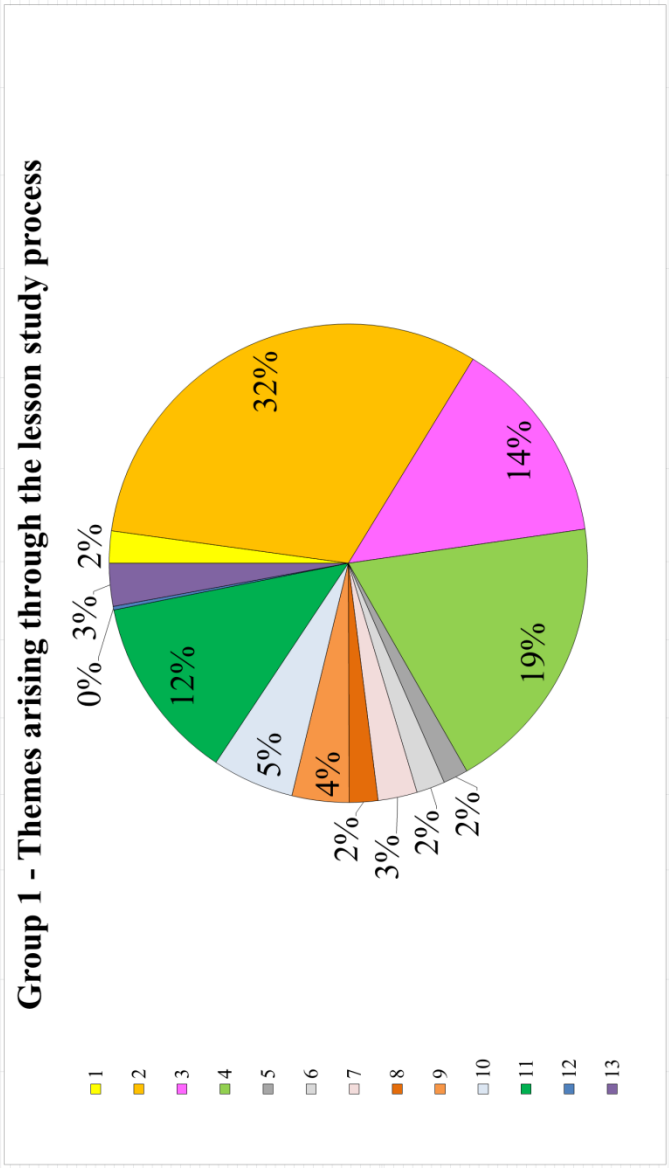
Video 15B

Writing reflections.

APPENDIX C – THEMES TIME SPENT

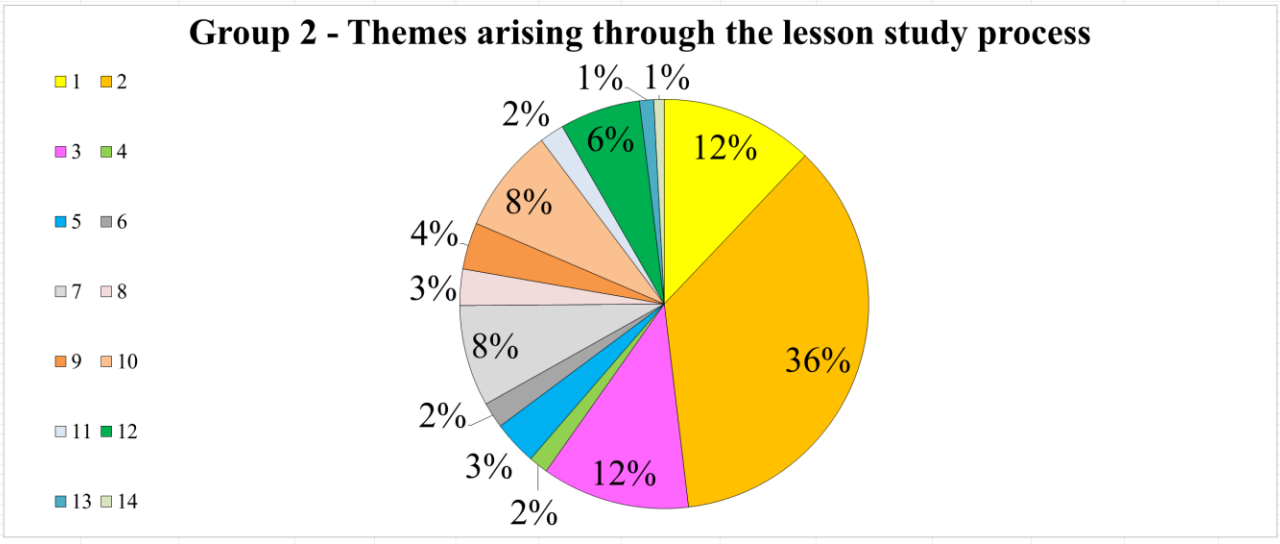
Group 1

	1. Teachers' math understanding and knowledge	2. Instructional skills and strategies	3. Students' thinking and understanding	4. Insight and positive comments on the lesson study process	5. Teacher as researcher	6. Student previous knowledge	7. Terminology / Language	8. Anticipated student response	9. Expectations for student learning and achievement	10. Challenges of the educational system	11. Coach guidance	12. Assessment	13. Group process and collegial learning experience
	8	25	8	13	1	4	11	1	3	12	6	1	1
	1	20	1	9	1	4		7	1	11	6		11
		27	13	57	1				4		1		
		25	21		4				5		39		
		34	15						3				
Total	9	131	58	79	7	8	11	8	16	23	52	1	12



Group 2

	1. Teachers' math understanding and knowledge	2. Instructional skills and strategies	3. Students' thinking and understanding	4. Insight and positive comments on the lesson study process	5. Critique on / resistance to / difficulty with the lesson study process	6. Teacher as researcher	7. Student previous knowledge	8. Terminology / Language	9. Anticipated student response	10. Expectations for student learning and achievement	11. Challenges of the educational system	12. Coach guidance	13. Assessment	14. Connecting to real-life experiences
	16	1	11	2	4	1	3	2	2	1	1	1	1	4
	1	5	2	2	2	2	4	1	1	2	4	1	1	1
	31	11	6	1	1	4	9	10	3	2	2	3	1	1
	9	22	15	1	18	3	1	10	1	8	2	3	2	2
	33	37	3	1	3	8	30	2	2	1	4	49	1	
	11	27	6	8	3	2	1	3	24	8	3	5	5	
	12	13	1		3		5		3	15	2			
	5	31	2				3			17	1			
		39	10				14			8				
		40	2				5			9				
		1	14				3			10				
		38	6											
		18	4											
		9	1											
		35	5											
		22	13											
		2	13											
Total	118	351	114	15	34	20	78	28	36	81	19	62	11	8



APPENDIX D – HSRB APPROVAL

GEORGE MASON UNIVERSITY
Office of Research Integrity and Assurance
Research Hall
4400 University Drive, MS 6D5, Fairfax, Virginia 22030
Phone: 703-993-4121; Fax: 703-993-9590

TO: Anastasia Kitsantas, College of Education and Human Development

FROM: Aurali Dade
Assistant Vice President, Research Compliance

PROTOCOL NO.: 8501 Research Category: Masters Thesis

PROPOSAL NO.: N/A

TITLE: Lesson study as an induction tool for novice teachers' performance

DATE: January 9, 2013

Cc: Orit Arditi

On 1/9/2013, the George Mason University Institutional Review Board (GMU IRB) reviewed and approved the above-cited protocol following expedited review procedures.

Please note the following:

1. **Any modification to your research (including the protocol, consent, advertisements, instruments, funding, etc.) must be submitted to the Office of Research Integrity & Assurance (ORIA) for review and approval prior to implementation.**
2. Any adverse events or unanticipated problems involving risks to subjects including problems involving confidentiality of the data identifying the participants must be reported to the ORIA and reviewed by the IRB.

The anniversary date of this study is 1/8/2014. **You may not collect data beyond that date without GMU IRB approval.** A continuing review form must be completed and submitted to the ORIA 30 days prior to the anniversary date or upon completion of the project. In addition, prior to that date, the ORIA will send you a reminder regarding continuing review procedures.

If you have any questions, please do not hesitate to contact me at 703-993-5381.

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