Teacher Collaboration: A Comparative Study using TIMSS & TALIS Data

By

Submitted in Partial Fulfillment
of the Requirements
for the Degree of

Masters of Science in Mathematics Education

May 2017

SUNY Buffalo State
State University of New York

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Date of Approval:

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Project Advisor

Abstract

Teachers in the United States work harder under more challenging conditions than teachers in other countries (Darling-Hammond, Chung Wei, Richardson, & Orphanos, 2009). Their work days are longer and they spend most of their time in the classroom teaching students. This leaves them little time to collaborate with other teachers to grow and develop in their profession. Many schools require their teachers to participate in professional development activities, but these are often short term and can sometimes focus on themes that are impractical for teachers' everyday application. We need our schools to provide teachers with opportunities to participate in extended learning activities and collaborative communities – two things that cannot be accomplished in a single day's activity. They need to be embedded in teachers' everyday job. Japanese schools model these types of collaboration in professional development, called Lesson Study. The following study explored what differences, if any, exist between United States and Japan on the following variables: Collaboration within the school day, collaboration within a grade level, collaboration within subject matter, collaboration across school levels – Middle School & High School, Professional development within the school day, Professional development outside of the school day. The 2015 report of Trends in International Mathematics and Science Study (TIMSS) and 2013 Teaching and Learning International Study (TALIS) both give evidence that teachers in the United States perceive that they have a high level of collaboration within their schools, especially when it comes to planning and preparing instructional materials and teaching jointly as a team. The data does not tell us what it is that defines collaborative activities for these teachers, however. Collaboration takes time and effort, which both TALIS 2013 and TIMSS 2015 state that teachers in the

United States do not have available to them. Both surveys report that teachers in Japan have more time and opportunities to collaborate within their schools. Teachers in Japan spend less time teaching math in a classroom than teachers in the U.S., which offers more time to meet and collaborate with their peers. Both TALIS 2013 and TIMSS 2015 give evidence that Japanese teachers spend a good deal of time visiting each other's classrooms, visiting other schools, and meeting regularly to discuss new teaching methods and how to improve their practice.

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Teacher Collaboration

CHAPTER 1

Introduction

Working conditions for teachers in the United States are much more challenging than teachers elsewhere in the industrial world. Teachers are assigned multiple courses to teach, sometimes as many as three or four. These often require ample preparation time, especially if a teacher is asked to teach a new course that they have never taught before. Teachers usually create their own lessons, write their own assessments, and then spend hours grading those assessments. In addition, teachers are expected to make time available to work individually with students before or after school hours and to communicate with parents to discuss their child's progress. Let's not forget that teachers spend the majority of their time in a classroom instructing students. So if teachers spend most of their time teaching students, when do they actually have time to grow and develop their thinking about teaching? When do they get to see other teachers and discuss what is going on in other classrooms? Here lies the problem – Most of a teacher's workload is completed alone, without the support from coworkers. Teachers are simply not given enough time to collaborate with each other and grow in their profession. This will be the focus of the study in the upcoming chapters. Specifically, the underlying question is what differences, if any, exist between countries participating in international assessments on the following variables: Collaboration within the school day, collaboration within a grade level, collaboration within subject matter, collaboration across school levels – middle School & high School, professional development within the school day, and professional development outside of the school day.

Lack of Support to Develop Curriculum

Implementation of the Common Core State Standards for Mathematics (CCSSM) is a cumbersome task for both teachers and administrators (2010). The big task when implementing the standards is to develop a curriculum that teachers can use in their practice. Curriculum can be described as a set of lessons, assessments and academic content taught in a school or specific course of study. One must understand that the CCSSM does not provide a curriculum for teachers. It is up to school policy makers and teachers to create a curriculum and determine the way the mathematical content described in the CCSS is taught. This can be extremely difficult for teachers. Teachers often work alone trying to interpret standards and determining how to translate them into their curriculum.

Teachers are expected to implement a curriculum. Teachers use a variety of resources such as textbooks, engage NY's curriculum modules, or online libraries that contain shared materials from other teachers. Teachers use these new resources along with old textbooks and assessments, combine them with our preexisting knowledge and ways of interpreting content, and then develop their curriculum. Unfortunately, the resources made available to teachers are subpar according to other countries, such as Japan, who leads the United States in student achievement when it comes to mathematics. Catherine Lewis compares teacher's manuals for textbooks that are used in the United States with those that are being used in Japan and point out some major areas of concern.

According to Lewis (Perry, Friedkin, & Roth, 2012) good textbooks contain teacher support for learning math content, attention to student thinking, and common assessments (p. 369). The type of textbooks that she is describing contain written explanations of how to solve mathematical problems. These can benefit the teacher who is teaching new math content for the first time. When implementing the CCSSM teachers must first interpret the math standards for their subject, then they need to be able to apply these standards within the context of a math problem. Teachers need to be able to understand the math problem that they are teaching before they can teach it to their students. Textbooks should also include potential strategies that students might use to solve math problems and various sample solutions. This helps prepare teachers for differentiation in their classrooms. Differentiation can be described as efforts that teachers make to respond to variance among learners in their classroom. Teachers must be able to reach out to individual or small groups to vary his or her teaching in order to create the best learning experience possible. Finally, textbooks need to include common assessments that teachers can use to determine whether their students understood the math content that was taught to them. Assessments make it easy for teachers "to investigate variations in teaching that produce differences in learning by different classes studying the same curriculum" (Saito, 2010, p. 184).

Lewis et al. (2012) discovered that nearly 10% of the written statements in the Japanese textbooks are devoted to providing rationale for pedagogical choices (p. 369). This may not seem high. However, such statements do not exist in U.S. textbooks. She also found that 28% of written statements in the Japanese textbooks anticipate varied student thinking. Whereas, only 1% of the statements in the U.S. textbooks contained this content. Lastly, the Japanese textbooks show teachers how to formatively evaluate their students during lessons. This can be used as a common assessment. Lewis did not comment on the type of assessment that was provided in the U.S. textbooks.

The fact that U.S. textbooks do not provide teachers with adequate support is a major concern in math education. If teachers cannot rely on textbooks to support developing their curriculum, where can they turn to for help? Naturally, teachers should be able to turn towards their peers for help. But, unfortunately, this is not the case.

Lack of Feedback from Coworkers

Linda Darling-Hammond (2009) analyzed working conditions by pulling data from the Organization for Economic Cooperation and Development's (OECD) Teaching and Learning International Survey (TALIS) (p. 15). What she found was that teachers in the United States receive much more feedback from principals than their peers. Nearly 85% of the teachers in the U.S. claim they received feedback from principals, which is higher than any other country who participated in the TALIS. On the other hand, less than 30% of teachers in the U.S. received feedback from their peers. The TALIS average for receiving peer feedback is roughly 45%. In some countries, like South Korea, as much as 90% of their teachers felt they received feedback from their peers. In the National Center for Education Statistics' Schools and Staffing Surveys only 17 percent of teachers in the U.S. felt that they were involved in cooperative efforts among staff members (Darling-Hammond, Chung Wei, Andree, Richardson, & Orphanos, 2009, p. 23). The reality is that teachers are simply not working together in their workplace. This makes implementing a curriculum much more strenuous because they do not have the opportunity to develop lessons together and discuss teaching approaches provide a path that fosters deeper thinking about the content we teach.

Lack of Time for Teachers to Do Their Work

Teachers in the United States work roughly 45 hours per week, and spend 27 of those hours directly instructing children in the classroom (Darling-Hammond, 2009, p. 15). The TALIS international average work week is 38 hours per week, with teachers spending an average of 19 hours per week directly instructing children. In a different survey, led by the

Association of Teachers and Lecture, 46% of teachers report that they work between six and ten hours during the weekend, while 28% work more than 10 hours (Hodge, 2015, p. 1). Teachers in the United States are not only working longer days and having to work weekends in order to keep up with the demands of the job, but they are also spending significantly more time in the classroom than teachers in other countries. This gives teachers less time in their schedules for developing curriculum, collaborating with peers to improve and learn new teaching methods, and to participate in professional development.

These heavy workloads make the teaching profession much less desirable, and sometimes forces teachers out of the profession. Kate Hodge (2015) reveals that 73% of trainee and newly certified teachers have thought about leaving the profession (p. 1). This can become a huge issue for a nation who is trying to implement a new set of math standards that plan to prepare students for a future where they will invent new work, team up to solve problems, develop new knowledge, and continuously acquire new skills. This task requires professionals who are highly-qualified and skilled in their craft! We do not only want to recruit the best and the brightest teachers, but we also want to retain them and allow them to improve their practice. We are facing a nationwide problem of needing to provide teachers with high-quality mathematics professional development at a level that will support the implementation of the CCSSM and allow them to opportunities for continued growth as professionals in their field.

A Call for Collaboration

A New Working Environment for Teachers

So how do teachers create an environment that will promote effective learning, while meeting the needs of the CCSSM? Administrators need to cultivate a professional team environment that allows for collaboration and continued learning. Barnett Barry (Daugherty & Wieder, 2009) claims that "when teachers are given time and tools to collaborate with their peers, they are more likely to teach effectively" (p. 1). When executed properly schools will notice a full-circle where administrators collaborate with teachers, teachers collaborate with each other, and students collaborate with their teachers and peers.

Not only will collaboration improve teacher effectiveness, but it will recruit and retain good teachers. Teachers need to enjoy the work that they do. Berry also reported that 64% of teachers who took the Teachers Network survey said they joined their schools because they wanted a professional community of teachers with whom they could collaborate with (Berry et al., 2009, p. 2).

Chapter 2

Literature Review

In order to compare the level of teacher collaboration and professional development in the United States with Japan, we need to study the theories and methods that teachers and administrators can apply to transform our schools into collaborative networks. This needs to be done first so that we can clearly understand what a collaborative teaching environment should look like. This will help us in our data analysis in Chapter 3 so that we know what factors to look for when comparing any differences between participating countries. The following sections provide background on research that has been done to define teacher collaboration.

Professional Development versus Collaboration

Professional development for teachers is defined as follows, "activities that develop an individual's skills, knowledge, expertise and other characteristics as a teacher" ("Creating Effective Teaching", 2010). Development can range from formal to informal activity. What differentiates collaboration from professional development is the type of activity that teachers engage in. Kanold and Carter (2012) explain that collaboration includes a team or group of educators (teachers, guidance counselors, administrators, etc.) who work towards a common goal to develop mathematics curriculum and to improve their practice.

Purposeful Professional Development

Schools usually mandate their teachers to participate in professional development activities. These are usually formal workshops whose theme focuses on a single topic. Workshops can be held in-service, where they invite guest speakers to offer useful strategies that can be used in the classroom. Sometimes, schools will offer teachers monetary compensation to attend out-of-service workshops on their own time. Usually, these types of professional development activities last for only a short amount of time, a day or two, and there is no follow up to make sure teachers are applying what they have learned in their professional development meetings. Research suggests that professional development of 14 hours or less has no effect on student learning (Darling-Hammond et al., 2009, p. 20). On the other hand, programs that last longer than 14 hours and are ongoing show positive and significant effects on student achievement.

It is also important that teachers are interested in the professional development that their schools are having them participate in. This can be accomplished through involving teachers in the decision-making process of school policy. Linda Darling-Hammond et al. (2009) explains,

> Professional development tends to be more effective when it is an integral part of the larger school reform effort, rather than when activities are isolated, having little to do with other initiatives or changes underway at the school. If teachers sense a disconnect between what they are urged to do in a professional development activity and what they are required to do according to local curriculum guidelines, texts, assessment practices, and so on—that is, if they cannot easily implement the strategies they learn, and the new practices are not supported or reinforced—then professional development tends to have little impact (p. 10).

Teachers and administrators should work together on developing syllabi, selecting textbooks and other instructional materials, developing curriculum and assessments, deciding on course offerings and departmental budget, and planning and scheduling for professional development. This long and careful consideration is a form of professional development in itself. By allowing teachers to participate in these activities, they will grow interested in professional development and feel like a valued member of their school.

Such professional development programs exist in countries like Singapore, who follow a "decentralized model" for teacher professional development (Darling-Hammond, 2010, p. 7). In the early 90's the Finnish educational system got rid of all formal in-service teacher education programs at the national level. They granted local schools and teachers a high level of autonomy, which allowed them to create professional development programs that focus on their own needs and goals. Schools follow a National curriculum, just like the U.S. follows the CCSSM, but they create their own plans for how their curriculum will be enacted. Their schools give teachers daily common planning which allows teachers to develop lessons together and discuss teaching approaches provide a path that fosters deeper thinking about the content we teach. Teachers and administrators work together to solve problems within their schools by applying evidence-based solutions and evaluating the effectiveness of their procedures. For example, a principal can meet with the math department at the beginning of a school year and share assessment data from the previous year. Together, they can discuss areas that need improvement and devise a set of school goals for the following year. The principal can frequently meet with the members of the math department to assess their performance, provide feedback and discuss what can be done differently to ensure their goals are being met.

How to Effectively Use Time

How do we make sure teachers are receiving proper time to collaborate with each other and to participate in purposeful professional development? The answer is quite simple - time for collaboration and professional development needs to be embedded in a school day. Linda Darling-Hammond (2014) explains,

> Collaboration requires time as well as the will to make it happen, and this means that school staffing and schedules must be designed differently. The TALIS data show that U.S. schools generally hire fewer teachers than schools in other countries. We need to rethink how we invest in and organize schools, so that time for extended professional learning and collaboration become the norm rather than the exception (p. 16).

What she is suggesting is that we release teachers from their teaching duty or other supervision, such as study hall proctoring, cafeteria monitoring, or hallway duties, etc., in order to collaborate with colleagues on a daily basis. This can be made possible by hiring more staff or substitute teachers. Schools should not be wasting the little amount of time that teachers have outside of the classroom participating in supervisory activities that will not help improve their teaching practice. Schools can assign staff, whom are not teacher certified, to fulfill these supervisory duties. Occasionally, teachers should be relieved of their classroom teaching duties by a substitute teacher so that they can spend 2 to 3 hours, or even an entire day, collaborating with peers or participating in meaningful professional development.

Timothy Kanold and John Carter (2012) describe some other strategies to ensure teachers receive time for collaboration and professional development (p. 15). One strategy includes providing common time by scheduling to most team members, if not all, the same period free from teaching during the day. A team usually consists of all members within a department. For example, all of the math teachers in a school would make up one team. Administrators can create an altered schedule that releases students early on an ongoing basis. If time is absolutely not available during the school day then schools can purchase teacher time by providing monetary district compensation for weekends and summer work. This would be beneficial for teachers who take on a new course prep. Often, there are week-long, sometimes month-long, training courses provided during the summer that help teachers prepare for teaching a new course in math. An alternative approach would be to use electronic applications, such as skype or video chats, so that teachers can meet with each other after school hours to engage in professional development.

Shifting from Isolation to Collaboration

When teachers spend a majority of their time teaching in the classroom, they are isolated from their colleagues. Some may view working in isolation as an advantage to their teaching practice. Teachers are able to develop autonomy in their classroom. Every teacher has their own set of classroom rules, procedures, and ways of teaching their content. Teachers have the power to change their curriculum as they see fit, and they will make those accommodations as long as they feel that it benefits their own students. For example, if a teacher does not believe in a lesson they are teaching then they can subvert it and change it. Similarly, if a teacher does not like a particular assessment then they will not use it. They can find another assessment that suits their students better.

In some ways protecting individual teacher autonomy can be beneficial to both the teacher and their body of students. But the potential harm this can cause towards both the student and other teachers in the building are much more severe. If an algebra 1 teacher teaches their students how to factor polynomials differently than the algebra 2 teacher, this may confuse the student in their later years. This will also make the job for the algebra 2 teacher much more difficult because they will now have to undo any teaching that has been done previously, and reteach it using their strategy. An even larger issue is that the teacher may alter their teaching method so that it is easier for their students to understand how to solve a problem. This can be troublesome because it might not align with the CCSSM and this will create issues for the student once they take their end of the year exam. It is possible that the teaching method could be ineffective, overall, causing the teacher to potentially fail their students over and over, again. Without someone to lean on for advice the teacher has no way of knowing that they are actually harming their students, and cannot talk to anyone to help them fix or improve their method of teaching.

In order to avoid these issues teaching must become a team sport. Teaching can no longer be about "my students", it should focus on "our students". Kanold and Carter (2012) both argue:

> The issue is not about protecting individual teacher autonomy. Rather, the issue is teaching and supporting your collaborative team autonomy with the tools necessary to collaboratively reflect and experiment in ways that are connected to the vision and mission of your school district and the CCSS, supported by research, and that have direct impact on improved student learning (p. 4).

Schools must assemble "collaborative teams" to build school interdependence. Teams can consist of everyone in the math department or everyone who teaches a specific subject. For example, all of the Algebra teachers can be placed on a team together. The teachers who are on this team need to work together with all of the math teachers and the school administrators to develop a common curriculum that aligns with the goals of both their school and the CCSSM. The collaborative teams will not walk into their school, knowing what their vision is right away. It is through peer interaction where the team will discover what their common goal is over time. These conversations need to occur on a daily basis throughout the school year.

Building a Professional Learning Community

We know that professional development in schools needs to be meaningful and that teachers need both the time and support to work together. Now that we have given teachers time to collaborate for professional development, what is the next step? Our aim is to build a Professional Learning Community (PLC), where teachers share their expertise and work collaboratively to improve both their mathematics teaching skills and the academic performance of their students. Japanese schools who participate in a professional development model, called Lesson Study, do a great job displaying the type of efforts that we expect to see among teachers who are members of a PLC. Susie Groves (Doig, Widjaja, Garner, & Palmer, 2013) explain how teachers in Japan act as researchers:

> Teams of teachers need to work as professional learning communities, where their mathematical knowledge for teaching is developed collaboratively and in an ongoing way, enabling them to teach within a problem-solving paradigm of mathematics teaching and learning (p. 14).

The classroom is their lab and the students are their subjects. Teaching needs to be a systematic approach to collecting data from formal and informal assessments and applying logical decision making techniques when planning their lessons, instead of generalizing solely from intuition. During this collaborative planning process teachers must keep two goals in mind: First, teaching needs to be directed towards developing student understanding of mathematics. Second, teachers need to build their math content knowledge while focusing on the student learning process.

The Collaborative Planning Process

The first step in the collaborative learning process is choosing a learning target. The collaborative team will meet and hold a discussion to try and understand what they want to accomplish with their students. That is, what is it that we want our students to understand and what do we want our students to be able to do? For example, in an algebra class the team might be interested in planning a unit on quadratic functions, and in this unit they need to teach a lesson on graphing a quadratic function from the vertex form of a parabola. In this lesson, students will be able to recognize when a parabola is written in vertex form and understand how to identify both the turning point and its general shape. Students will be able to complete the square to transform a quadratic function into its vertex form, then graph it. Once these goals have been established the team will then engage in discussions about their math knowledge on quadratic functions and their knowledge about how to teach this lesson. These discussions can include sharing some of their favorite problems and instructional materials for this unit, explaining how they have taught this unit in the past, or how they would like to teach the unit this year.

As these discussions transpire, remember, teachers need to focus on their students' learning process. A major segment in a Lesson Study is researching methods that can be used to teach the lesson and carefully selecting rich mathematical tasks that will both motivate and engage students in solving problems. Teacher need to be cognizant of the variability of learners in their class and the individual needs that each of those learners holds. To prepare for a lesson teachers need to know how their students think and learn. Susie Groves et al. (2013) advocates that the most effective way to understand how our students learn is to solve the problem first-hand:

> Having first-hand experience in solving the mathematical problem and discussing the attributes of various solutions was instrumental in helping teachers anticipate the learning potential for students and possible misconceptions students might have when working on the problem. Furthermore, engaging in solving the mathematical problems provided teachers with opportunities to deepen their mathematical content knowledge (p. 12).

Teachers need to carefully select the math problems that they are using for both their lessons and their assessments. When a teacher solves the problem before using it in a lesson, they are able to identify the level of difficulty of the problem. Is the task too difficult for your students? If so, you can select an easier task and progressively build up to the more difficult tasks. Solving the problem beforehand will help the teacher identify common misconceptions and struggling points. This will allow the teacher to anticipate questions that their students might ask, or give them time to come up with scaffolding techniques that will help push their students through the sticking points. As teachers go through this process they will naturally deepen their own understanding of the concept, making them a very skillful and experienced educator.

Once a lesson has been developed the collaborative team will discuss the lesson together and make revisions. They will continue to do this for each lesson, and while doing so, they will also consider the pacing of the unit. How long should we spend on each lesson so that we ensure the majority of our students will grasp the concepts, while allowing enough time to finish our curriculum before the end of the school year? Teachers can coordinate work tasks to help lighten the load for each other. This way teachers are not spending hours doing busy work such as typing lessons or making copies of materials. It will give them more time to meet with each other to discuss their students' needs and how they will perform their lesson. Next, teachers will create their common assessments. All students who are taking the same course need to take the same tests and quizzes. This is the best way to measure both student performance and teacher effectiveness fairly across an entire school. Common assessments will ultimately tell us if our students achieved the goals that we set for them and if our teaching was effective.

The Collaborative Reflection Process

As teachers we cannot expect every lesson to be a success. Teaching is a learning process for us just as much as it is for our students. The final, most important step in the collaboration process is reflecting on our lessons and working together to improve our practice. Lesson Study is one method that teachers can use accomplish this. In a Lesson Study it is common for teachers to observe each other's lesson and then meet afterwards to discuss ways to improve it. Eisuke Saito and Maasaki Sato (2012) recommend that the observation should focus on four categories, including the process of the lesson, failure of the children, relationships and responsiveness, and differences and gaps (p. 184). Together the observers, the teacher who taught the lesson, and the members who contributed to developing the lesson will discuss the positive and strong points based on the facts and evidence observed during the lesson. Sometimes the flaws and shortcomings of the lessons can be discussed. After experiencing the lesson the teacher who taught the lesson will describe specific contexts with specific names of children. They should be able to analyze these contexts and discuss possible solutions to the corresponding problems and difficulties. Discussing the lessons strengths and limitations helps teachers increase their knowledge of pedagogy and math content (Kanold & Carter, 2012, p. 23).

It is not always easy for teachers to open their practice to others for observation and to receive criticism from their peers. Teachers work very hard to develop their lessons and hold a sense of pride when it comes to their work. So it is extremely important to trust and respect each other (Kanold & Carter, 2012, p. 9). Teachers cannot develop trust immediately – it takes time and commitment from everyone one in the workplace, and it begins with the leaders of the school. For example, a Junior High School in Japan adopted Lesson Study for school reform and experienced a huge turn-around in becoming one of the most successful schools in Japan (Saito & Sato, 2012, p. 185). At first the teachers were apprehensive to participate in a lesson study. To persuade the teachers into participating the principal of the school performed a lesson study himself and allowed his teachers to observe him. Before the lesson study was performed he attended their daily lessons and personally provided feedback. Eventually, everyone felt comfortable enough to perform their own lesson study. The teachers developed a culture of collegiality, where they trusted each other's' professional opinions.

Lesson Study is not the only practice that can be used to ensure teachers are reflecting to improve their practice. Teachers can collect data on their own to determine if their instructional decisions had an impact on student learning. This can be an informal conversation between two or more teachers explaining how they perceived their lesson. Did the lesson go smoothly when you taught it? Did students appear to understand what they were learning, or was there a lot of confusion? On the other hand, teachers can use assessment data to determine if students understood their lesson. Did students make a lot of mistakes? If so, were these mistakes common among the class or the school? Which problems did a majority of our students get correct? Teachers will then use these assessments to drive their decisions when planning their curriculum in the future. It is important to adjust your lessons so that we keep what worked for our students and remove what didn't work. We want prevent our students from making the same mistakes again, while aiming to make our lesson more effective the next time we teach it.

Another reflection process that teachers can use to improve their practice is videotaping lessons. In 2002 teachers in the United States and Japan performed a major study where lessons on finding the area of a triangle were taught by teachers from both countries (Jacobs & Morita, 2002). Both lessons were videotaped, then assessed by a group of teachers. The teachers assessed the lessons using data coding. For example, each time a teacher said something about the lesson their statement was coded as an "idea unit". These idea units were classified as a strength or a weakness and were then placed in categories. For example, one of the categories were "pace and timing" of the lesson. This allowed teachers to compare the effectiveness of their teaching practices. The researchers wanted to compare math pedagogy of both countries on a much larger scale. However, what they did was open the door for possibilities for teachers to engage in a very meaningful professional development activity. Teachers who do not have time in their schedule to observe each other can videotape their lessons. The videos can be shared with each other for critiquing, or, teachers can just watch their own lessons as a way to help themselves improve their teaching.

Continued Learning and Mentorship Programs

We live in a changing world, where students' needs and learning styles shift from day to day. How can we expect our teachers to be prepared to enter the classroom with just a college degree? The answer is quite simple - teachers cannot expect to effectively do their job without continuing professional development, interaction with their peers, and critical reflection. It is when teachers do not receive these three things that they leave the profession. Or even worse, they stay and deteriorate, harming their students by not providing them with their best possible teaching. We need to recruit the best and the brightest, invest in the development of our teachers, and keep them in the profession. We want our teachers to feel supported and to reach their highest potential as professional educators.

In Singapore, participating in professional development is a cultural norm for teachers across the country. The Singapore Ministry of Education established the Teacher's Network in 1998, where their nation's vision "aims to produce life-long learners by making schools a learning environment for everyone from teachers to policymakers and having knowledge spiral up and down the system" (Darling-Hammond et al., 2009, p. 17). Some examples of professional development activities are Learning Circles. In a Learning Circle, 4-10 teachers and one facilitator meet for eight 2 hour sessions over a period of 4-12 months. The facilitator is an experienced teacher who encourages teachers to act as co-learners and critical friends who share their teaching beliefs and methods, try new ideas and practices, and exchange their classroom experiences with each other.

In some states, like New York, teachers are required to participate in a mentored experience and professional development. Once teachers complete their undergraduate degree and a series of teaching certification exams, they will receive their initial teaching certificate. Teachers will then work towards obtaining a professional certificate, where they must complete a master's degree in an education-related program. Teachers also need three full years of teaching experience, with one year as a mentored experience. What mentorship programs are available? Are mentorship experiences collaborative? Once teachers obtain their professional certification they are required to participate in 175 hours of professional development every 5 years. Are teachers barely meeting these requirements or are they actually involved in much more professional development? Also, are professional development activities collaborative?

CHAPTER 3

Methodology

This chapter will describe the process for analyzing existing data from international assessments to gain a clear picture the attitudes and perceptions among teachers and principals. These data will be used to reveal what differences, if any, exist between countries participating in the international assessments on the following variables: Collaboration within the school day, collaboration within a grade level, collaboration within subject matter, collaboration across school levels – Middle School & High School, Professional development within the school day, Professional development outside of the school day.

Background of International Assessments

Trends in International Mathematics and Science Study (TIMSS)

The Trends in International Mathematics and Science Study (TIMSS) will be the first international assessment used in this study (Martin, Mullis & Hooper, 2016). TIMSS is a comparative study used to measure mathematics and science achievement of 4th and 8th grade students. The first TIMSS was conducted in 1995, and has been conducted every 4 years since then. The sixth, and most recent, TIMMS study was conducted in 2015. TIMSS was developed and implemented by the International Association for the Evaluation of Educational Achievement (IEA), which is an international organization of national research institutions and governmental research agencies. TIMSS collects data using two instruments: comprehensive assessments and contextual questionnaires. The comprehensive assessments provide useful information about student performance and problem solving challenges in different areas of math and science such as algebra, geometry, biology, and chemistry. On the other hand, the context questionnaires share the attitudes and perceptions of students, teachers, and school principals. This information can provide insight into effective educational strategies that can be used for teacher development and improvement.

Teaching and Learning International Study (TALIS)

The second international assessment that we will use in this study is the Teaching and Learning International Study (TALIS) (Strizek, Tourkin & Erberber, 2014). The TALIS is a worldwide evaluation on the conditions of teaching and learning. The TALIS is relatively new, compared to the TIMSS. It has only been performed twice, in 2008 and in 2013. It is coordinated by the Organization for Economic Operation and Development (OECD), which provides a forum in which governments can work together to share experiences and seek solutions to common problems. TALIS is a survey designed to be completed by teachers and school principals . The aim is to collect data that reveals information of lower secondary education; such as initial teacher education and professional development, what type of feedback teachers get, school climate, school leadership, and teachers' instructional beliefs and pedagogical practices. The feedback is then analyzed and compared to help countries identify others facing similar challenges and learn about their educational policies. Results are published in the form of international reports, interactive databases, individual country notes and thematic reports.

Participants in TIMSS 2015 Study

TIMSS 2015 used a two-stage random sample design to select its participants. In the first stage a sample of schools are drawn. Then, one or more classes of students from each of the sampled schools are selected in the second stage. All students from each class are selected, rather than individual students from across the grade level. The reason for this is that TIMSS focuses on students' curricular and instructional experiences, which are organized on a classroom basis (LaRoche, Joncas & Foy, p. 1, 2016). The international target population for TIMSS is defined by the amount of schooling students have received. All schools are eligible to participate in TIMSS, no matter the school type (public, private, charter, magnet, etc.), as long as those schools have students enrolled in the target grade. The target grade is 8th grade students. TIMSS defines the 8th grade student population "eight years after the first year of International Standard Classification of Education (ISCED) Level 1" (LaRoche, Joncas & Foy, p. 3, 2016). The average age at the time of testing is at least 13.5 years. If students were less than 13.5 years of age at the time of testing, TIMSS used students at the 9th grade level. Students within the selected class was asked to complete both the assessment and student questionnaire. The teacher of each participating 8th grade class was asked to complete the teacher questionnaire. Similarly, the principal of every participating school was asked to complete a school questionnaire. In this paper, results of both teacher and school questionnaires are used. Comparisons are made between teachers of eights grade students and principals of participating schools from United States and Japan.

United States

In the United States, there were a total of 300 schools that participated in TIMSS 2015 study. 10,221 students were assessed among a total of 11,489 students in participating schools

(see Appendix C.6 for a table showing student sample sizes). The average age of students at the time of testing was 14.2 years of age. The sample schools were chosen by three explicit categorical stratification variables: poverty level (high or low); school type (public or private); and census region (Northeast, Central, West, Southeast). The explicit stratification selects the sample so that the regional proportions are equal to those with the total population. Sample schools were selected by two implicit stratification variables: urbanization (city, suburb, town, rural) and state/district (50 states and District of Columbia). The proportion within sample schools in these implicit stratifications is close to the proportion of the total population. First, schools were selected nationwide based on the above criteria. Next, there were two mathematics classes sampled within each participating school. Lastly, all of the students in the chosen classes are selected for assessment and the teacher of the chosen class is selected to complete the questionnaire. Students were excluded if they were classified as having the following conditions: intellectual disabilities, functional disabilities, or non-native language speakers. These sample selection procedures ensure the sample selected from TIMSS 2015 study represents all schools in United States.

Japan

In Japan, 150 schools participated in TIMSS 2015 study. 4,745 students were assessed among a total of 5,037 students in participating schools. The average age of students at the time of testing was 14.5 years of age. The sample schools were chosen by two explicit categorical stratification variables: urbanization (non-city, small city, large city, very large city) and school type (public junior high school, combined public junior and senior high school, private school). The explicit stratification selects the sample so that the regional proportions are equal to those with the total population. No implicit stratification were used to select sample schools. Special needs schools were excluded from the sample selection process. In each school, only one classroom was selected to participate. All students in the selected classroom were assessed; except for students with intellectual disabilities, students with functional disabilities, and non-native language speakers. The teacher of every selected class completed the teacher questionnaire.

Participants in TALIS 2013 Study

TALIS 2013 used a stratified two-stage probability sampling design to select its participants. In the first stage a sample of schools were randomly selected. Participating countries were given the opportunity to use either an explicit stratification, implicit stratification, or both in order to better suit their national needs. If explicit stratification was used, the method used to select school samples was systematic random sampling with probability proportional to size within explicit strata. For implicit stratification, schools in explicit strata were sorted by implicit strata and measure of size before the sampling process. After the sample schools were selected, teachers who met the target population requirements were selected from each of the randomly selected schools.

The international target population for TALIS is defined as schools that provide International Standard Classification of Education (ISCED) Level 2 and the teachers and principals who work in those schools (Strizek, Tourkin & Erberber, p. 73, 2014). Students who enter ISCED level 2 range between ages 10 and 13, where 12 is the most common. This level of education is referred to as lower secondary or middle school. All schools are eligible to participate in TALIS, no matter the school type (public, private, charter, magnet, etc.), as long as those schools have students enrolled in the target ISCED level. Schools that were excluded from the sample were schools exclusively for adult education or schools exclusively for students with special needs. The target sample size was 200 schools per country. Teachers who provide instruction in classes filled with students at ISCED level 2 were asked to participate in the teacher questionnaire, whether they taught only one class or multiple classes with students at that level. Teachers who were excluded from the sample were substitute teachers, teachers who were on long-term leave, or teachers who are acting as both teacher and principal. Finally, the principal of every school selected were asked to participate in the principal questionnaire. Participating countries were given the option of surveying teachers and principals of ISCED Levels 1 and 3. However, only the results of both teacher and school questionnaires at ISCED level 2 are used in this paper.

The target sample size was 200 schools per country and 20 teachers per school. Thus, resulting in 4,000 teachers and 200 principals for each participating country. Participating countries were given the option to improve their national sample by selecting more schools, or by selecting more teachers, or both. A reason countries might do this is the expected level of non-response from teachers. If there were less than 200 schools that contain classes at ISCED Level 2, then all of the schools were selected to participate. In this paper, comparisons are made between teachers of ISCED level 2 students and principals of participating schools from United States and Japan.

United States

In the United States, there are a total of 68,030 schools operating at ISCED Level 2. Of those schools, only 200 were selected to participate in TALIS 2013. 22 teachers were randomly selected from each participating school. If the school had 22 or fewer teachers at ISCED Level 2, then all of the teachers in that school were selected. A total of 4,000 teachers nationwide were selected to participate in the survey. The sample schools were chosen using two explicit stratification variables: school type (public or private) and grade structure (middle-junior school, high school, or other). The sample schools were chosen using three implicit stratification variables: region (Northeast, Midwest, South, and West); percent minority students; and number of ISCED Level 2 teachers (measure of size). Schools were then sorted by a hierarchal combination of the implicit stratum variables. The purpose of this was to improve the representativeness of the sample across these variables.

Japan

In Japan, there were 10,863 schools that contain ISCED Level 2 students. Of those schools, only 200 were selected to participate in TALIS 2013. 20 teachers were randomly selected from each participating school, resulting in a total of 4,000 participants. The sample schools were chosen using two explicit stratification variables: school type (public or private) and urbanization (non-city, small city, large city, very large city). Implicit stratification was not used.

Instruments in TIMSS 2015 Study

The instrument used in TIMSS 2015 is the Context Questionnaire Framework for eighth grade (Hooper, Mullis & Martin, 2016). TIMSS distributed four types of questionnaires – Student Questionnaire, Teacher Questionnaire, School Questionnaire and Curriculum Questionnaire. The types of questions in each of the questionnaires consist of single choice, multiple choice, scale choice and fill-in-the-blank. Only the teacher and school questionnaires were used in this study.

Teacher Questionnaire

The Teacher Questionnaires were completed by the teachers of each participating 8^{th} grade class. The goal if this questionnaire was to collect data about teachers' formal education, professional development, experience in teaching, and attitude and perception toward teaching mathematics in their school. The questionnaire had 28 questions. The sections were “about you”, “school emphasis on academic success”, “school environment”, “about being a teacher”, “about teaching the TIMSS class”, “teaching mathematics to the TIMSS class”, “using calculators and computers for teaching mathematics to the TIMSS class”, “mathematics topics taught to the TIMSS class”, “mathematics homework for the TIMSS class”, “mathematics assessment for the TIMSS class”, and “preparation to teach mathematics”. We will take a look at specific questions from sections on “school emphasis on academic success”, “about being a teacher”, “teaching mathematics to a TIMSS class”, and “preparation to teach mathematics” in this paper.

School Questionnaire

The School Questionnaires are made to be completed by the principal of each sample school. This questionnaire collected data about student demographics, the learning and teaching resources made available to students and teachers, type of science and mathematics programs, students’ learning environment, and principals’ attitude and perception toward the teaching and learning of science and mathematics in their school. There were 28 questions in this questionnaire. The sections were labeled “school enrollment and characteristics”, “instructional time”, “resources and technology”, “school emphasis on academic success”, “teachers in your school”, and “principal experience and education”. Only questions from the following sections will be used in this paper: “instructional time”, “teachers in your school”, and ““principal experience and education”.

Instruments in TALIS 2013 Study

TALIS uses two survey instruments to collect its data - Teacher Questionnaire and Principal Questionnaire (Rutkowski et al., 2013). The questionnaires cover the following topics: antecedents, school inputs, processes and school outputs. Classification of each topic is provided below in Table 2:

Table 2: A classification of the core parts of TALIS 2013 questionnaires

	Teacher Questionnaire	Principal Questionnaire
Antecedents	Teacher background characteristics	Principal background characteristics
School *input*	Student characteristics as perceived by the teacher	School background characteristics
	Teacher continuous professional development	Continuous professional development for the principal
Processes	School leadership and management	School leadership and management
	Teacher feedback	Teacher formal appraisal
	Teachers' instructional beliefs	Teachers' instructional beliefs and pedagogical practices
	Teachers' pedagogical practices	
School *output*	School climate and school management	School climate
	Teacher efficacy (aggregated to school level)	
	Teacher satisfaction (aggregated to school level)	Principal satisfaction

The types of questions in each of the questionnaires consist of single choice, multiple choice, scale choice and fill-in-the-blank.

Data Collection in TIMSS 2015 Study

The data in this paper is taken from both *TIMSS 2015 International Results in Mathematics: Eighth Grade Mathematic*s (Mullis, Martin, Foy & Hooper, 2016) and the TIMSS 2015 database. The database is available online at http://timssandpirls.bc.edu/timss2015/international-database/.

From the Teacher Questionnaire, questions 7d, 10a – 10g, 17, and 27 are discussed in this paper. The responses to those questions reveal the amount of instructional time, the level of collaboration and professional development in each school, as well as the type of collaboration and professional that takes place in each school. In the School Questionnaire, questions 18d are used in this paper. The responses to those questions include amount of instructional time, collaboration across schools, and teacher evaluations and feedback. All of the above questions are available in the TIMSS 2015 appendix.

Data Collection in TALIS 2013 Study

The data in this paper is taken from both Country Notes and *TALIS 2013 Results: An International Persepctive on Teaching and Learning* (OECD, 2014). Country Notes are available online at availablehttp://www.oecd.org/edu/school/talis-country-notes-and-country-profiles.htm. From the Teacher Questionnaire, questions 16, 17, 18, 21, and 33 are used. The responses to those questions reveal the amount of instructional time, the amount of time spent collaborating in a team, the amount and type of professional development, availability of induction programs and mentoring, amount and type of feedback received from other teachers and principals, and involvement in school decision-making. In the Principal Questionnaire, question 7 is used in this paper. The responses to those questions include professional development for teachers, level of collaboration with teachers and other principals, school decision-making, communication, opportunities for induction programs and mentoring. All of the above questions are available in annex H of the *TALIS 2013 Technical Report* .

Data Analysis

We are going to compare the level of teacher collaboration and professional development in the United States with Japan. We will discuss the results of specific items that deal with time, collaboration, and professional development on the teacher and principal questionnaires for both TIMSS 2015 and TALIS 2013. The differences in responses will be tested by statistics tests. All statistic tests were conducted using a $\alpha = 0.01$ significance level. SPSS is the software used in each statistics test.

First, an independent t-test will be conducted to compare amount of instructional time (in minutes) in one week between American teachers and Japanese teachers. The TIMSS 2015 data did not include a standard deviation, so I calculated it on my own. Assuming that the distribution of data is approximately Normal, I used the first, second and third quartiles to calculate the standard deviation for the American teachers' data. Quartile 1 included 219 hours, Quartile 2 included 250 hours, and Quartile 3 included 280 hours. Since Q1 and Q2 are approximately 0.67 standard deviations above and below Q2, I was able to calculate the standard deviation of approximately 44.8 hours. To calculate the standard deviation for the Japanese teachers' data I used the Range Rule of Thumb, which says that the range is four times the standard deviation. However, I used the 5^{th} percentile and the 95^{th} percentile values to calculate the range. The range for the Japanese data was 65 hours. Dividing this value by 4, I calculated a standard deviation of approximately 16.25 hours.

TIMSS 2015 contains several questions about level of collaboration and professional development, which were used in this study. The responses to these questions were created using either a Likert scale or multiple choice. For each of these questions I calculated the weighted mean of responses and used an independent t-test to compare the differences in means. One of the questions in TALIS 2013 was also created using a Likert scale. Teachers' responses are presented using numbers from 1 to 6. I captured the proportion of lower secondary teachers who answered question 1, which means they reported never doing the following activities. Then, I compared these differences using a two sample z-test for the difference between population proportions. Additional questions in TALIS 2013 talked about teachers' work and type of professional development they participated in. Responses were summarized using both bar graphs and pie charts in the TALIS 2013 results. I used these graphs to identify and record any significant differences.

Chapter 4

Results

As discussed in Chapter 2 Japanese educators practice an admirable professional development model, known as Lesson Study. Japanese students also rank five in mathematic achievement (586) in the TIMSS 2015 Study; whereas, United States ranks eleven (518). Due to my strong interest in Japan's Lesson Study and their level of math achievement I want to know what their teachers are doing that is different from those in the United States. First, I am going to compare results from both teacher and school (principal) questionnaires in TIMSS 2015 to see if there are significant differences in the level of professional development and collaboration. Then I am going to compare results from both teacher and principal questionnaires in TALIS 2013.

TIMSS 2015 Study

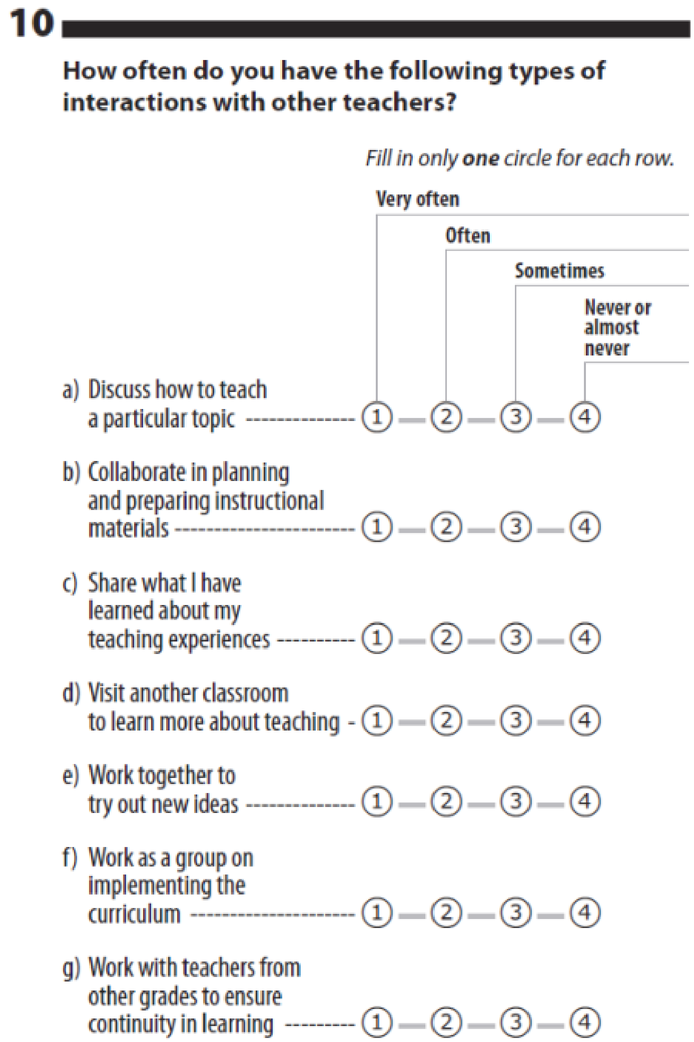
The 2015 TIMSS data from the teacher questionnaire allowed for comparisons to be made between participating countries. First, an independent t-test was conducted to compare amount of instructional time (in minutes) in one week between American teachers and Japanese teachers. The TIMSS 2015 data did not include a standard deviation, so I calculated it on my own. Assuming that the distribution of data is approximately Normal, I used the first, second and third quartiles to calculate the standard deviation for the American teachers' data. Quartile 1 included 219 hours, Quartile 2 included 250 hours, and Quartile 3 included 280 hours. Since Q1 and Q2 are approximately 0.67 standard deviations above and below Q2, I was able to calculate the standard deviation of approximately 44.8 hours. To calculate the standard deviation for the Japanese teachers' data I used the Range Rule of Thumb, which says that the range is four times the standard deviation. However, I used the 5th percentile and the 95th percentile values to calculate the range. The range for the Japanese data was 65 hours. Dividing this value by 4, I calculated a standard deviation of approximately 16.25 hours. Table 1 shows there is difference in American teachers' instructional time (M=258.1min., SD=44.8) and Japanese teachers' instructional time (M=155.6min., SD=16.25). As expected, the American mean is significantly higher than the Japanese mean. However, the results suggest that there is insufficient evidence to say there is a significant difference between the amount of instructional time in both countries $t(576)=0.919$, $p>0.01$.

Table 1

Independent sample t-test for teachers' response to questions about the amount of instructional time

Country	n	Mean	SD	t	df	Sig. (2-tailed)
United States	348	258.1	44.8	0.919	576	0.3583
Japan	230	155.6	16.25			

With time being a factor during the day; if teachers spend most of their time teaching students this could limit the amount of time they have left to collaborate with their colleagues, unless, schools manage to embed collaboration into their daily practice. Next, we will look at a number of questions that will allow us to compare teachers' attitudes and perceptions about the level of collaboration they believe actually occurs in their school. All of the responses that dealt with collaboration were significantly different, except for the responses about working with teachers from other grades. After checking teachers' responses Table 2 summarizes the mean responses to the questions about collaboration. The collaboration questions are shown below.



10

How often do you have the following types of interactions with other teachers?

Fill in only ***one*** *circle for each row.*

	Very often	Often	Sometimes	Never or almost never
a) Discuss how to teach a particular topic	1	2	3	4
b) Collaborate in planning and preparing instructional materials	1	2	3	4
c) Share what I have learned about my teaching experiences	1	2	3	4
d) Visit another classroom to learn more about teaching	1	2	3	4
e) Work together to try out new ideas	1	2	3	4
f) Work as a group on implementing the curriculum	1	2	3	4
g) Work with teachers from other grades to ensure continuity in learning	1	2	3	4

Figure 1. TIMS 2015 Teacher Collaboration Questions

Teachers' responses are presented using numbers from 1 to 4. The number 1 means teachers believe the interaction occurs very often, and 4 means teachers believe the interaction never or almost never occurs. For example, when looking at teachers' responses to the question "How often do you discuss how to teach a particular topic with other teachers", the mean response of American teachers is 2.1 while 2.6 for Japanese teachers, which indicates that Japanese teachers have less interactions with teachers about discussing how to teach a particular topic. Question c was omitted from the study. Independent t-tests were used to check the difference in teacher's response between the two countries, with a significance level of $\alpha = 0.01$. Each difference was statistically significant $p < 0.01$ except for question g, where $p > 0.01$. The difference was statistically nonsignificant.

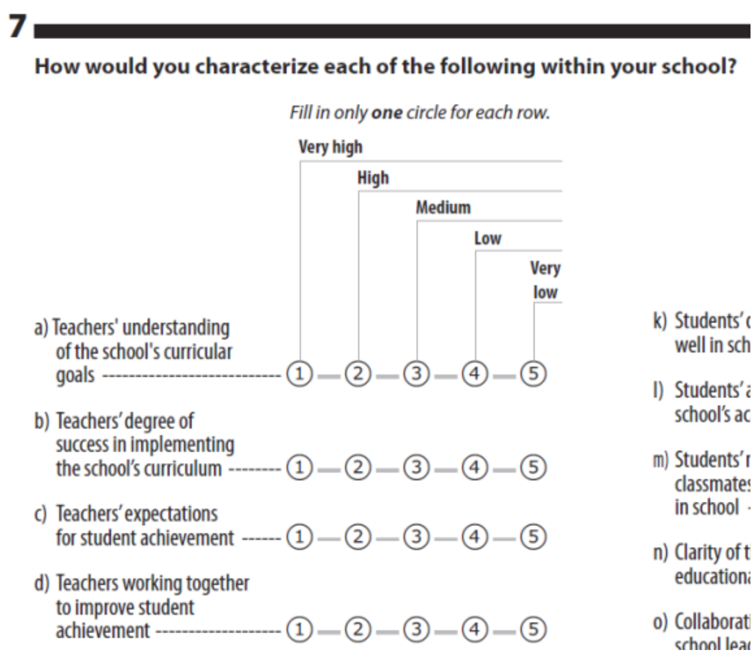
Table 2

Independent sample t-test for teachers' response to questions about the type of collaboration

	United States		Japan				
How often do you have the following types…	n	Mean (SD)	n	Mean (SD)	t	df	Sig. (2-tailed)
a) Discuss how to teach a particular topic	369	2.135 (0.907)	229	2.612 (0.712)	8.075	596	0.000
b) Collaborate in planning and preparing instructional materials	369	1.979 (0.992)	229	2.841 (0.736)	12.565	596	0.000
d) Visit another classroom to learn about teaching	369	3.321 (0.828)	229	2.684 (0.646)	12.968	596	0.000
e) Work together to try new ideas	369	2.538 (0.963)	229	2.831 (0.725)	4.496	596	0.000
f) Work as a group on implementing the curriculum	369	2.248 (0.957)	229	2.955 (0.726)	10.961	596	0.000
g) Work with teachers from other grades to ensure continuity in learning	369	2.883 (0.878)	229	2.967 (0.799)	1.385	596	0.1665

In Table 2, it is obvious that American teachers' responses (M=3.3, SD=0.8) and Japanese Teachers' responses (M=2.684, SD =0.6) to questions about visiting other classrooms to learn about teaching 10(d) are different. The difference is significantly different by an independent sample test t(596)=12.968, p=0.000. This is not surprising due to the fact that in a Lesson Study, teachers are known to visit and observe their peers to learn new pedagogical methods and procedures, and to help improve their practice. Moreover, different opinions also occur in American teachers' responses (M=1.98, SD=0.99) and Japanese teachers' responses (M=2.8, SD=0.7) to question 10(b) about collaborating in planning and preparing instructional materials. The differences are significantly different t(596)=12.565, p=0.000. The differences suggest that American teachers feel they collaborate more often than Japanese teachers, which is very surprising.

One additional question was used in this study to determine if the differences in level of teacher collaboration between United States and Japan are significant. The same question was given to both teachers and their building principal. Tables 3 & 4 summarizes the mean responses from teachers and principals, respectively. Questions 7d and 18d were the only questions used, and are shown below.


7

How would you characterize each of the following within your school?

*Fill in only **one** circle for each row.*

Very high | High | Medium | Low | Very low

a) Teachers' understanding of the school's curricular goals ① — ② — ③ — ④ — ⑤

b) Teachers' degree of success in implementing the school's curriculum ① — ② — ③ — ④ — ⑤

c) Teachers' expectations for student achievement ① — ② — ③ — ④ — ⑤

d) Teachers working together to improve student achievement ① — ② — ③ — ④ — ⑤

k) Students' well in sch

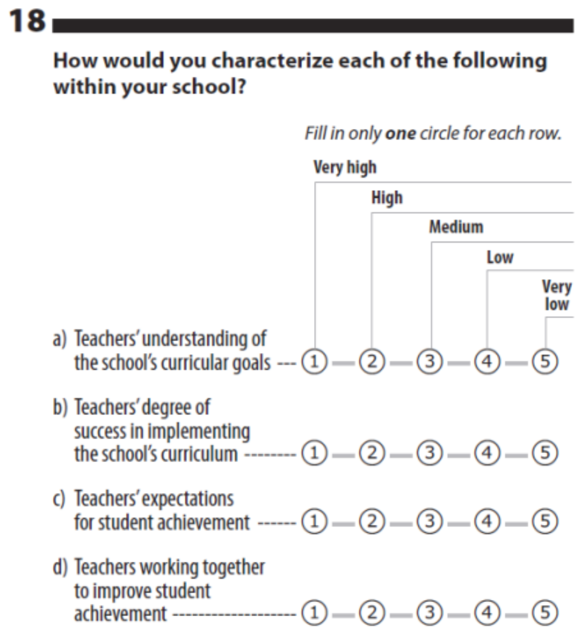
l) Students' school's ac

m) Students' classmates in school

n) Clarity of t education

o) Collaborati

Figure 2. TIMSS 2015 Teacher Questionnaire Collaboration Question



18

How would you characterize each of the following within your school?

*Fill in only **one** circle for each row.*

	Very high	High	Medium	Low	Very low
a) Teachers' understanding of the school's curricular goals	①	②	③	④	⑤
b) Teachers' degree of success in implementing the school's curriculum	①	②	③	④	⑤
c) Teachers' expectations for student achievement	①	②	③	④	⑤
d) Teachers working together to improve student achievement	①	②	③	④	⑤

Figure 3. TIMSS 2015 Principal Questionnaire Collaboration Question

Both teachers' and principals' responses are presented using numbers from 1 to 5. The number 1 means they believe that teacher collaboration is very high, and 5 means they believe that teacher collaboration is very low. For example, the question asks "How would you characterize teachers working together to improve student achievement within your school", the mean response of American teachers is 2.0 while 2.2 for Japanese teachers, which indicates that Japanese teachers collaborate less than teachers in United States. Similarly, the mean response for American principals is 2.1 while 2.3 for Japanese principals. This also indicates that Japanese teachers collaborate less. Independent t-tests were used to check the difference in both teacher's response and principal's response between the two countries, with a significance level of $\alpha = 0.01$. Each difference was statistically significant with $p < 0.01$ in both t-tests.

Table 3						
Independent sample t-test for teachers' response to questions about teacher collaboration						
Country	n	Mean	SD	t	df	Sig. (2-tailed)
United States	371	2.041	0.852	2.878	598	0.0041
Japan	229	2.188	0.645			

Table 4						
Independent sample t-test for principals' response to questions about teacher collaboration						
Country	n	Mean	SD	t	df	Sig. (2-tailed)
United States	219	2.082	0.7597	3.696	364	0.0003
Japan	147	2.292	0.6831			

Table 3 clearly shows that American teachers' responses ($M=2.0$, $SD=0.9$) and Japanese Teachers' responses ($M=2.2$, $SD=0.6$) to the question about teacher collaboration are different. An independent sample test revealed the difference is significant with $t(598)=2.878$, $p=0.0041$. Also, Table 4 shows that American principals' responses ($M=2.1$, $SD=0.8$) and Japanese Teachers' responses ($M=2.3$, $SD=0.7$) to the question about teacher collaboration are different. Again, an independent sample test showed the difference is significant with $t(364)=3.696$, $p=0.0003$. Both t-tests suggest that American teachers collaborate more than teachers in Japan. But notice, in both countries principals feel that their teachers collaborate slightly less than what teachers believe. This may be due to the fact that teachers spend more time interacting with each other during a school day without the presence of their principals. Principals have more duties and responsibilities than teachers, which means they might not be able to see when collaboration actually exists.

Table 5 shows the result of detecting the amount of professional development teachers participate in. Responses were recorded in TIMSS 2015 teacher questionnaire, shown in figure 4.

27

In the past two years, how many hours in total have you spent in formal in-service/professional development (e.g., workshops, seminars) for mathematics?

Fill in ***one*** *circle only.*

None---- ①
Less than 6 hours---- ②
6–15 hours---- ③
16–35 hours---- ④
More than 35 hours---- ⑤

Figure 4. TIMSS 2015 Professional Development Questions

Teachers' responses are presented using numbers from 1 to 5. The number 1 means they have participated in no professional development in the past two years, and 5 means they have participated in more than 35 hours of professional development in the past two years. For example, the question asks "in the past two years, how many hours in total have you spent in formal in-service/professional development", the mean response of American teachers is 3.6 while 2.5 for Japanese teachers, which indicates that Japanese teachers spend less time participating in professional development than teachers in United States. There is no way of calculating the exact number of hours that teachers have participated in because each numbered response has includes a range of hours. I calculated the weighted average of responses, and then used independent sample t-tests with $\alpha = 0.01$ significance level to determine if the differences in amount of professional development were statistically significant. Table 5 displays the summary of the test, as shown below.

Table 5

Independent sample t-test for teachers' response to questions about the amount of professional development

Country	n	Mean	SD	t	df	Sig. (2-tailed)
United States	366	3.624	1.134	9.836	594	0.000
Japan	230	2.524	1.182			

In Table 5, we can see that American teachers' responses (M=3.6, SD=1.1) and Japanese Teachers' responses (M=2.5, SD =1.2) to the question about professional development are different. The difference is significantly different be an independent sample test t(594)=9.836, p=0.000. One reason why American teachers recorded a higher response might be due to the amount of mandatory professional development requirements that teachers must meet in order to maintain their teacher certification. The question also does not clearly outline what types of professional development that teachers participate in – it is very vague. For instance, most teachers might view professional development strictly as in-service workshops, presentations, or classes and conferences that teachers attend on their own time. These types of activities are commonly labeled and recognized as "professional development". However, what most teachers do not realize is that collaboration that occurs in teachers' daily practice is also a form of professional development. This question does not take collaboration into account, which is why we have looked at a number of responses that dealt with collaboration in this study.

TALIS 2013 Results

The next set of data that was used in this study are teacher and principal responses from TALIS 2013. The responses from these surveys allowed for comparisons to be made between participating countries. First, I compared teachers' work in United States and Japan by analyzing the graphs provided by TALIS 2013. These graphs allowed us to see where teachers in both participating countries spend their time throughout the course of a work day. Figures 5 and 6 display teachers' work below.

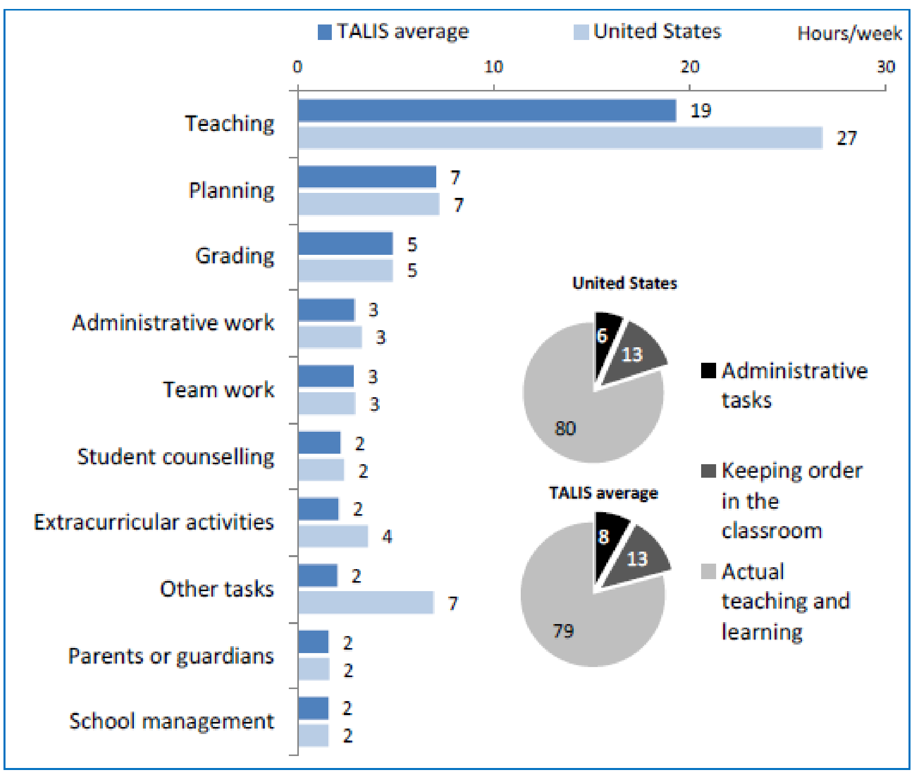


Figure 5. Teacher's work in United States

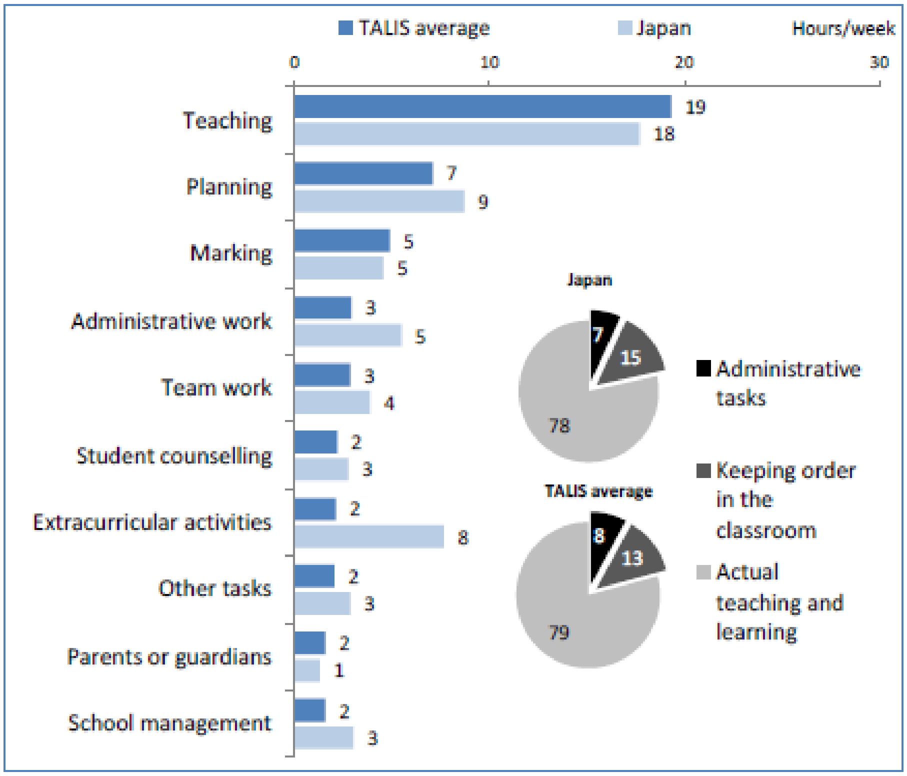


Figure 6. Teacher's work in Japan

The TALIS average work week for teachers is 38 hours per week. Teachers in the United States work 45 hours per week on average, where teachers in Japan work 54 hours a week. Both are well above the international average, however, teachers in Japan work much longer weeks than teachers in United States. What I find more striking is that teachers in the United States spend 27 hours per week teaching in a classroom, where teachers in Japan only spend 18 hours per week teaching. So, teachers in the U.S. spend approximately 60% of their time in a classroom with students. On the other hand teachers in Japan spend only 35% of their time in a classroom with students. Teachers in both countries are working much longer days than most other countries, especially teachers in Japan. However, a large portion of teachers' time in the United States is taken up by teaching in a classroom full of students. This gives teachers less time in their schedules for developing curriculum, collaborating with peers to improve and learn new teaching methods, and to participate in professional development. All of these are critical in the collaboration process.

Next, we will compare participation rates and average number of days for types of professional development between teachers in United States and Japan. Figures 7 and 8 display professional development below.

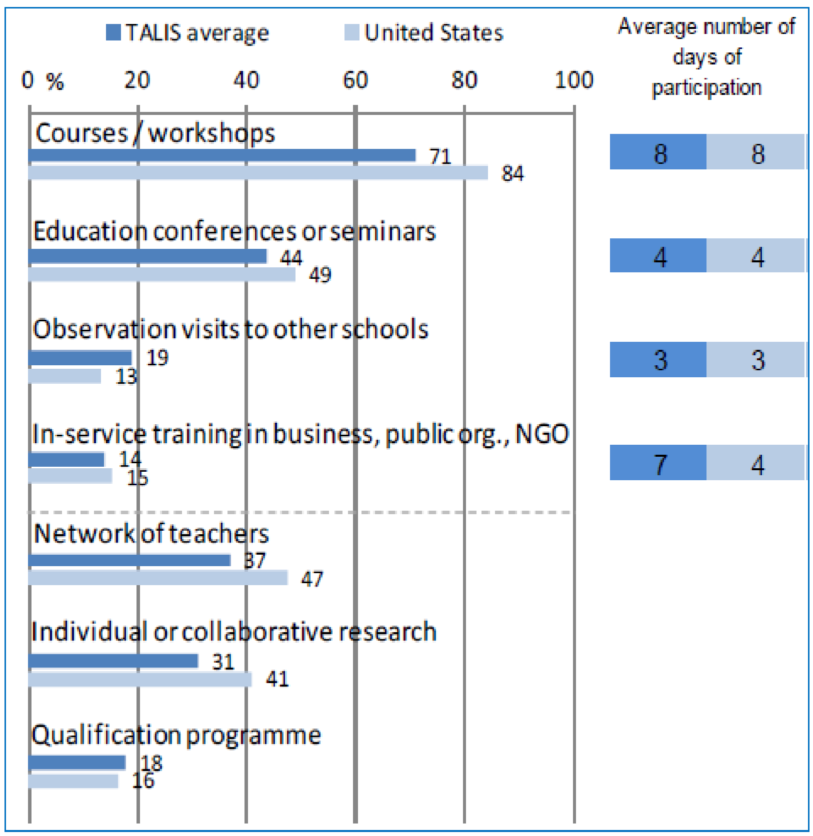


Figure 7. Participation Rates in Professional Development in U.S.

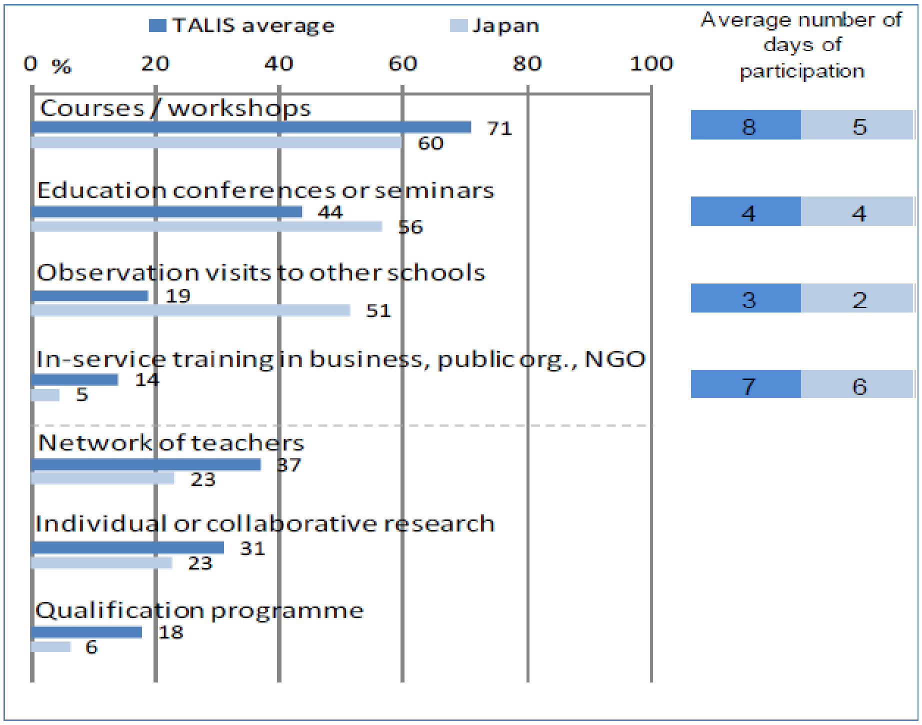


Figure 8. Participation Rates in Professional Development in Japan

Teachers in the United States reported having a higher rate in most professional development internationally. 84% of U.S. teachers participated in courses and workshops, where only 60% in Japan. It is no surprise that Japanese teachers reported a higher participation rate than U.S. teachers when it came to observation visits to other schools. 51% of Japanese teachers participated in observation visits, where only 13% in U.S. What stood out to me was that teachers in the United States reported much higher than Japanese teachers in both networking with teachers and collaborative research. 47% of U.S. teachers participated in networking, where only 23% in Japan. Also, 41% of U.S. teachers participated in collaborative research. On the other hand, only 23% of Japanese teachers participated in collaborative research.

Lastly, we will look at a number of questions that allow us to compare teachers' attitudes and perceptions about the level of collaboration they believe actually occurs in their school. All of the responses that dealt with collaboration were significantly different, except for the responses about engaging in discussions about the learning development of specific students. After checking teachers' responses Table 6 summarizes the mean responses to the questions about collaboration. The collaboration questions are shown below in figure 9.

33. On average, how often do you do the following in this school?

Please mark one choice in each row.

			Never	Once a year or less	2-4 times a year	5-10 times a year	1-3 times a month	Once a week or more
TT2G33A	a)	Teach jointly as a team in the same class ..	☐1	☐2	☐3	☐4	☐5	☐6
TT2G33B	b)	Observe other teachers' classes and provide feedback	☐1	☐2	☐3	☐4	☐5	☐6
TT2G33C	c)	Engage in joint activities across different classes and age groups (e.g. projects)	☐1	☐2	☐3	☐4	☐5	☐6
TT2G33D	d)	Exchange teaching materials with colleagues	☐1	☐2	☐3	☐4	☐5	☐6
TT2G33E	e)	Engage in discussions about the learning development of specific students	☐1	☐2	☐3	☐4	☐5	☐6
TT2G33F	f)	Work with other teachers in my school to ensure common standards in evaluations for assessing student progress	☐1	☐2	☐3	☐4	☐5	☐6
TT2G33G	g)	Attend team conferences	☐1	☐2	☐3	☐4	☐5	☐6
TT2G33H	h)	Take part in collaborative professional learning	☐1	☐2	☐3	☐4	☐5	☐6

Figure 9. TALIS 2013 Questions about Collaboration

Teachers' responses are presented using numbers from 1 to 6. I captured the proportion of lower secondary teachers who answered question 1, which means they reported never doing the following activities. Then, I compared these differences using a two sample z-test for the difference between population proportions with $\alpha = 0.01$

significance level. Only questions a, b, d, e, f and h were used. To help understand the data used in this significance test, take for example, the question "On average, how often do you observe other teachers' classes and provide feedback". The 2,148 represents the number of American teachers, out of the 4,000 participants, who answered "never". The 53.7% represents the proportion (percentage) of those teachers who selected that same answer. For Japan 244 teachers answered "never", which represents 6.1% of the participants in the study. As you can see there is a huge difference in these responses. In fact, each difference among the responses to the three questions was statistically significant $p < 0.01$ except for question e, where $p > 0.01$. The difference was statistically nonsignificant.

Table 6						
Two proportion z-test for teachers' response to questions about the type of collaboration						
	United States		Japan			
On average, how often do you *never* do the following…	n	p (%)	n	p (%)	z	Sig. (2-tailed)
a) Teach jointly as a team in the same class	4,000	2,148 (53.7%)	4,000	1,360 (34.0%)	17.755	0.000
b) Observe other teachers' classes and provide feedback	4,000	2,008 (50.2%)	4,000	244 (6.1%)	43.853	0.000
d) Exchange teaching materials with colleagues	4,000	368 (9.2%)	4,000	812 (11.1%)	-13.99	0.000
e) Engage in discussions about the learning development of specific students	4,000	200 (5.0%)	4,000	240 (6.0%)	-1.962	0.0498
f) Work with other teachers in my school to ensure common standards in evaluations for assessing student progress	4,000	556 (13.9%)	4,000	664 (16.6%)	-3.359	0.0008
h) Take part in collaborative professional learning	4,000	372 (9.3%)	4,000	752 (18.8%)	-12.226	0.000

In Table 6, it is obvious that American teachers' responses (50.2%) and Japanese Teachers' responses (6.1%) to questions about observing other teachers' classes and providing feedback 33(b) are different. The difference is significantly different by an independent two proportion test z=43.853, p=0.000. It is not surprising that a small percentage of Japanese teachers reported never visiting other classrooms because in Japan Lesson Study is very common. In a Lesson Study teachers do visit other classrooms to observe their peers and provide them with feedback. Moreover, there is a difference in the response of American teachers (53.7%) and Japanese teachers (34%) who report never teach jointly as a team in the same class (question 33(a)). The difference is significantly different $z=17.755$, $p=0.000$. These results confirm that teachers in the United States tend to work in isolation from their colleagues. Different opinions also occur in American teachers' responses (9.3%) and Japanese teachers' responses (18.8%) to question 33(h) about collaborative professional learning. The differences are significantly different $z=-12.226$, $p=0.000$. The differences suggest that American teachers feel they collaborate more often than Japanese teachers, which is very surprising due to the results we have found in questions 33(a) and 33(b).

Chapter 5

Discussions and Conclusions

This study's aim was to find factors measured in TIMSS 2015 and TALIS 2013 that can account for differences between Japanese and U.S. 8th grade teachers and the level of collaboration that exists within their schools. One major finding is that although American teachers' perception is that their levels of collaboration are very high among their staff, they simply do not have as many opportunities to collaborate as Japanese teachers. In TIMSS 2015 responses from both teachers and principals about level of collaboration (questions 10 and 18) showed us that teachers in the United States believed that they collaborate more than teachers in Japan. Results from TALIS 2013 supports this evidence in question 33(h) about collaborating for professional learning. The results shows that due to the lack of time, teachers are not physically able to meet with each other in order for collaboration to occur. Question 17 from TIMSS 2015 and questions 17 and 18 from TALIS 2013 provide evidence that teachers in the United States spend more time teaching than teachers in Japan, which gives them less time to meet as a team to collaborate.

Results from both TIMSS 2015 and TALIS 2013 continue to prove that Japanese teachers have more opportunity to collaborate than American teachers. Question 10(d) in TIMSS 2015 and question 33(b) in TALIS 2013 both ask teachers about visiting each other's' classrooms. American teachers' responses in TIMSS 2015 had a Mean=3.3, while the Japanese teachers' responses contained a Mean=2.684. In TALIS 2013, 50.2% of American teachers reported never visiting other teachers' classrooms, while only 6.1% in Japan. These data show us that teachers in Japan visit each other's' classrooms more than teachers in United States. The results in TIMSS 2015 were significantly different by an independent sample test t(596)=12.968, p=0.000. Similarly, the results in TALIS 2013 were significantly different by an independent two proportion test z=43.853, p=0.000. The combined results of TALIS 2013 and TIMSS 2015 confirms that teachers in the United States absolutely work more independently than teachers in Japan. Teachers in Japan see each other more during the course of a school day, which gives them more opportunity to collaborate as a team. Because teachers in Japan visit each other's classrooms more frequently than teachers in the United States, we can conclude that they have more opportunities to critique each other and provide positive feedback. It is through these types of reflective processes that allow teachers to continue to grow and develop as professional educators.

Question 10(b) in TIMSS 2015 asks teachers about collaborating to plan and prepare teaching materials, while question 33(d) in TALIS 2013 asks teachers about exchanging teaching materials. American teachers' responses in TIMSS 2015 had a Mean=1.98 and Japanese teachers' responses averaged with a Mean=2.8. These data explain that American teachers actually collaborate to plan and prepare instructional materials more than teachers in Japan. The differences were significantly different by an independent sample test t(596)=12.565, p=0.000. In TALIS 2013, only 9.2% of American teachers never exchange materials, while 11.1% never do in Japan. This tells us that American teachers are more comfortable sharing their instructional materials with others. The difference was significantly different by an independent two proportion test z=-13.999, p=0.000. The combined results of TIMSS 2015 and TALIS 2013 provide us with concrete evidence that, although teachers in the United States don't visit each other's classrooms as much as teachers in Japan, they definitely work together as a team to prepare materials that can be used for teaching in their classroom. However, just because they are "working together" doesn't necessarily mean that these efforts are collaborative. Working collaboratively to plan and prepare materials requires much more effort than just delegating tasks or handing off materials to other teachers. Teachers must first find a common planning time. Then, within that time period teachers need to plan, develop, and discuss how they are going to deliver appropriate lessons to address focal skills and concepts. All of this should be done collaboratively to increase the chances that their students will develop competency in the area that has been targeted for improvement. Are teachers actually spending time during their school day doing this? Or, are they sharing materials and delegating tasks for convenience - to get their work done quicker and more efficiently? This certainly leaves us with something to think about and suggests that this can be studied more in depth in the future.

TIMSS 2015 question 27 and TALIS 2013 question 21 both provide teachers' responses about level of professional development that occurs in their schools. Although teachers in the United States participate in more professional development than Japan, this does not guarantee that in these meetings teachers are collaborating to grow in their profession. There does not seem to be enough evidence to conclude who collaborate more, Japanese teachers or American teachers. We can only conclude that Japanese teachers have greater opportunity to collaborate within a school day. And that American teachers believe that the work they are doing is collaborative. In order to find evidence we would need to conduct individual interviews with teachers to gain a clear understanding of the type of work that they do within a school day. Then, we could match it with our research in

Chapter 2 to see if those efforts are collaborative efforts that help teachers to grow and improve in their profession.

TALIS 2013 reports that teachers in the United States have one of the highest rates in professional development. In fact, 84% of U.S. teachers participated in courses and workshops. On the other hand, only 60% of Japanese teachers reported this. This is not surprising because teachers in the United States must go through many years of schooling to become a teacher, and they are usually required to attend rigorous training programs to maintain their teaching certification. This evidence does not prove that teachers actually collaborate when participating in these courses and workshops. Japanese teachers spend much more time participating in observation visits. 51% of Japanese teachers participated in observation visits, where only 13% in U.S. This makes sense because many teachers in Japan participate in Lesson Study, which calls for observation visits. This is also more evidence that teachers in Japan are given more opportunities to collaborate across schools and school districts. 13% still seems very high for teachers in the U.S. to observe teachers in other schools. This calls for further investigation. It is surprising that teachers in the United States reported much higher than Japanese teachers in both networking with teachers and collaborative research. 47% of U.S. teachers participated in networking, where only 23% in Japan. Also, 41% of U.S. teachers participated in collaborative research. On the other hand, only 23% of Japanese teachers participated in collaborative research. I would like to know how teachers in both countries define networking with peers and collaborative research. How much of that networking is dedicated to Lesson Study for teachers in Japan? Also, what type of activities take place in these networks? Are they collaborative activities that allow teachers to discuss ways and methods to grow and improve in their practice?

Collaboration is a mindset for teachers. Different teachers have different ways of thinking and what it means to be in a collaborative community. Unfortunately, the responses in this study do not necessarily define what type of collaboration is actually occurring among teachers. This raises some good questions for further research. Is there a way for us to understand "what is it exactly that defines collaboration for these teachers who participated in these surveys? What activities define collaboration for them?" In question 33(a) from TALIS 2013 teachers are asked about teaching jointly as a team in the same classroom. The question does not specify whether the teacher is teaching jointly with others in the same subject/discipline. When teachers collaborate, plan, and teach jointly as a team, are they doing these activities with teachers in the same discipline? Or, are they doing this with teachers outside of their discipline? This is an important question because collaboration amongst teachers should be done within the same discipline. This allows teachers to expand and grow within their subject content.

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Appendix

Table 7

Questions chosen from TIMSS 2015 Teacher Questionnaire

Question 10

10

How often do you have the following types of interactions with other teachers?

Fill in only ***one*** *circle for each row.*

	Very often	Often	Sometimes	Never or almost never
a) Discuss how to teach a particular topic	1	2	3	4
b) Collaborate in planning and preparing instructional materials	1	2	3	4
c) Share what I have learned about my teaching experiences	1	2	3	4
d) Visit another classroom to learn more about teaching	1	2	3	4
e) Work together to try out new ideas	1	2	3	4
f) Work as a group on implementing the curriculum	1	2	3	4
g) Work with teachers from other grades to ensure continuity in learning	1	2	3	4

Question 17

17

In a typical week, how much time do you spend teaching mathematics to the students in this class?

____________ minutes per week

Write in the number of minutes per week.
Please convert the number of hours into minutes.

Teacher Collaboration

Question 27

27

In the past two years, how many hours in total have you spent in formal in-service/professional development (e.g., workshops, seminars) for mathematics?

*Fill in **one** circle only.*

None ---- ①

Less than 6 hours ---- ②

6–15 hours ---- ③

16–35 hours ---- ④

More than 35 hours ---- ⑤

Questions chosen from TIMSS 2015 School Questionnaire

Question 18

18

How would you characterize each of the following within your school?

*Fill in only **one** circle for each row.*

	Very high	High	Medium	Low	Very low
a) Teachers' understanding of the school's curricular goals	①	②	③	④	⑤
b) Teachers' degree of success in implementing the school's curriculum	①	②	③	④	⑤
c) Teachers' expectations for student achievement	①	②	③	④	⑤
d) Teachers working together to improve student achievement	①	②	③	④	⑤

Questions chosen from TALIS 2013 Teacher Questionnaire

Question 16

16. During your most recent complete calendar week, approximately how many 60-minute hours did you spend in total on teaching, planning lessons, marking, collaborating with other teachers, participating in staff meetings and on other tasks related to your job at this school?

A 'complete' calendar week is one that was not shortened by breaks, public holidays, sick leave, etc.

Also include tasks that took place during weekends, evenings or other off classroom hours.

Round to the nearest whole hour.

TT2G16 |__|__| Hours

Question 17

17. Of this total, how many 60-minute hours did you spend on teaching during your most recent complete calendar week?

Please only count actual teaching time.

Time spent on preparation, marking, etc. will be recorded in Question [18].

TT2G17 |__|__| Hours

Question 18

18. As a teacher of this school, during your most recent complete calendar week, how many 60-minute hours did you spend on the following tasks?

Also include tasks that took place during weekends, evenings or other off classroom hours. Please exclude all time spent teaching as this was recorded in the previous question.

Rough estimates are sufficient.

If you did not perform the task during the most recent complete calendar week, write 0 (zero).

TT2G18A	a)	|__|__|	Individual planning or preparation of lessons either at school or out of school
TT2G18B	b)	|__|__|	Team work and dialogue with colleagues within this school
TT2G18C	c)	|__|__|	Marking/correcting of student work
TT2G18D	d)	|__|__|	Students counselling (including student supervision, virtual counselling, career guidance and delinquency guidance)
TT2G18E	e)	|__|__|	Participation in school management
TT2G18F	f)	|__|__|	General administrative work (including communication, paperwork and other clerical duties you undertake in your job as a teacher)
TT2G18G	g)	|__|__|	Communication and co-operation with parents or guardians
TT2G18H	h)	|__|__|	Engaging in extracurricular activities (e.g. sports and cultural activities after school)
TT2G18I	i)	|__|__|	Other tasks

Question 21

21. I. During the last <u>12 months</u>, did you participate in any of the following professional development activities, and if yes, for how many days did they last?

Please indicate 'Yes' or 'No' in part (A) for each of the activities listed below. If 'Yes' in part (A), please specify the number of days spent on the activity in part (B).

Please sum up the activities in full days (a full day is 6-8 hours). Please include activities taking place during weekends, evenings or other off work hours.

			(A) Participation		(B) Duration in days
			Yes	No	
TT2G21A1-A2	a)	Courses/workshops (e.g. on subject matter or methods and/or other education-related topics)	□1	□2	⎣_⎣_⎣_⎦
TT2G21B1-B2	b)	Education conferences or seminars (where teachers and/or researchers present their research results and discuss educational issues)	□1	□2	⎣_⎣_⎣_⎦
TT2G21C1-C2	c)	Observation visits to other schools	□1	□2	⎣_⎣_⎣_⎦
TT2G21D1-D2	d)	Observation visits to business premises, public organisations, non-governmental organisations	□1	□2	⎣_⎣_⎣_⎦
TT2G21E1-E2	e)	In-service training courses in business premises, public organisations, non-governmental organisations	□1	□2	⎣_⎣_⎣_⎦

II. During the last <u>12 months</u>, did you participate in any of these activities?

Please indicate 'Yes' or 'No' for each of the activities listed below.

			Yes	No
TT2G21F	f)	Qualification programme (e.g. a degree programme)	□1	□2
TT2G21G	g)	Participation in a network of teachers formed specifically for the professional development of teachers	□1	□2
TT2G21H	h)	Individual or collaborative research on a topic of interest to you professionally	□1	□2
TT2G21I	i)	Mentoring and/or peer observation and coaching, as part of a formal school arrangement	□1	□2