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Kyozaikenkyu: An In-Depth Look into Japanese Educators' Daily Planning Practices

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A thesis submitted to the faculty of
Brigham Young University
in partial fulfillment of the requirements for the degree of

Master of Arts

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ABSTRACT

Kyozaikenkyu: An In-Depth Look into Japanese Educators' Daily Planning Practices

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Master of Arts

This study is in response to the question about how Japanese educators achieve such a high quality of instruction. Considering the area of lesson study has opened the door to new ideas and concepts that are not well defined and too broad to understand. *Kyozaikenkyu* is an aspect of lesson study that has been said to be a crucial aspect to successful lesson study. *Kyozaikenkyu* is done on a daily basis by Japanese educators; however, there is very little written about this process in relevant literature. This study examines what Japanese educators do during their daily *kyozaikenkyu*, and why they do it. Through interviews, observations, and participation in *kyozaikenkyu*, I have been able to describe a process many Japanese educators go through to prepare their lessons. There is a difference between what these educators do during *kyozaikenkyu* for a research lesson compared to the *kyozaikenkyu* of a daily lesson. I document two variations of daily *kyozaikenkyu*. One variation corresponds well to the *kyozaikenkyu* done for a research lesson, while the other variation is something new. This thesis expounds on those differences as well as explores the purposes and benefits of daily *kyozaikenkyu* for the Japanese educators that participated in them.

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This study would never have happened without the help of Hiroyuki Ninomiya. He met with me weekly via skype and then provided a place for me to stay while I was in Japan. He also provided me with the connections that I needed to make while in Japan to help me with this study. Through his help, I was able to make friends and networks that I will be able to collaborate with for the rest of my career.

I would also like to thank everyone who provided me with encouragement and positive reinforcement during this journey. I have been inspired, encouraged, and humbled along the way, which has totally changed my viewpoint not only in research, but in how I view the world.

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CHAPTER 1: RATIONALE

I taught mathematics for six years in a public high school. Having come out of an undergraduate in mathematics education, I was excited to try my hand at all the amazing things that I learned about an investigative approach to teaching mathematics. I student taught with teachers who were excellent at implementing this approach, and I saw the good it could do for the students. I found a job at the high school where I student taught, and I was excited to work with these professionals and develop my skills as a teacher. I soon found that trying to teach from an investigative approach was more difficult than I had anticipated. Students seemed disinterested and unwilling to investigate the assigned problems. They were unable to connect the investigative problem to the procedural understanding that was required of them on exams and finals. It seemed that the high quality of instruction I witnessed in my colleagues was unobtainable for myself. I knew that I still wanted to continue with an investigative approach, but something was missing from its success.

When I came back to school to further my education, I decided that I wanted to study high quality instruction to discover that missing piece. In my undergraduate courses, we studied the TIMMS videos which are recordings of Japanese lessons which were considered some of the best from an investigative approach (Hiebert, 2003); therefore, I decided to consider what Japanese teachers were doing to make their lessons high quality. It seemed a great fit for my research due in part to the fact that I have lived in Japan and speak the language fluently.

In recent studies about Japanese classrooms, researchers have written about how Japanese teachers have high quality instruction (Corey, Peterson, Lewis, & Bukarau, 2010; Stigler & Hiebert, 1999). High quality instruction is defined as providing greater opportunities for students to think deeply about richer mathematics and develop a solid understanding of

mathematical ideas (Stigler and Hiebert, 1999). One theory explaining why Japanese educators have high quality instruction is an activity that Japanese teachers participate in called *lesson study*. Lesson study occurs when teachers, professors, and administrators collaborate to plan, teach, and discuss a specific lesson (Fujii, 2013). Japanese educators do not do lesson study for every lesson they teach because, as described, it is a process involving much time and many participants. Japanese teachers, however, use the precepts learned in lesson study to improve their day-to-day teaching.

In recent decades, attempts have been made for classroom instruction to model the Japanese structured problem-solving approach. There have been some specific examples in Australia and the United States where some reform movements have been unable to reproduce the same effects on their instruction as the Japanese teachers who teach using the same approach (Doig, Groves, & Fujii, 2011). There is a specific example that is expounded upon in the literature review in which a group of teachers find success in preparing lessons from a Japanese approach when given materials for their preparation (Lewis et al., 2011). This example demonstrates that Japanese educators excel in preparing materials for their lessons where teachers from the United States and Australia fell short. *Kyozaikenkyu*, translated as *instructional materials research*, is central to a Japanese educator's planning process for their everyday lessons (Watanabe, Takahashi & Yoshida, 2008). Therefore, my research has led me to study the portion of the lesson preparation called *kyozaikenkyu.*

Upon researching *kyozaikenkyu*, researchers talk about the importance of it in lesson study. For example, Takahashi's (2006) study demonstrated how significant a deep and meaningful *kyozaikenkyu* is to lesson study. Indeed, Takahashi and Yoshida state, "A deep and

critical *kyozaikenkyu* is an essential component of successful lesson study" (Takahashi &

Yoshida, 2004).

Although *kyozaikenkyu* is a central component to Japanese educator's lesson study, there

is still very little known about *kyozaikenkyu* and how Japanese teachers engage in this process.

The practice of *kyozaikenkyu* is not captured well by the direct translation--*instructional*

materials research–as it is lacking in meaning and depth of what Japanese educators do during

kyozaikenkyu. Just like other cultural activities, the name is not enough to capture a deep

understanding of the practice. Some researchers have attempted to describe *kyozaikenkyu*;

however, the descriptions differ greatly in meaning. One researcher describes *kyozaikenkyu* as

"investigating what kind of materials various textbooks use to teach this topic to students, and

what research suggests (if anything) about various methods for teaching the topic" (Takahashi,

2006). This description expands on the direct translation to help define what *instructional*

materials are. In this case, *instructional materials* are described as textbooks, other teacher's

lesson plans, teacher magazines, books about teaching, and possibly research articles about

various methods of teaching. However, another description of *kyozaikenkyu* was given almost a

decade earlier that claims:

> *Kyozaikenkyu* refers to the careful analysis of the topic in accordance with the
>
> objective(s) of the lesson. It includes analyses of the mathematical connections both
>
> among the current and previous topics (and forthcoming ones, in some cases) and within
>
> the topic. Also included are the anticipation of students' approaches to the problem and
>
> the planning of instructional activities based on the anticipated responses. (Shimizu,
>
> 1999)

Shimizu's (1999) description of *kyozaikenkyu* does not include textbooks or research of various teaching methods; instead, he expands the description of what kind of activities that take place during *kyozaikenkyu*. Although these two descriptions do not necessarily contradict one another, they claim very different ideas about the nature of *kyozaikenkyu*. For example, it is unclear if *kyozaikenkyu* is studying just the instructional materials used for the lesson or if *kyozaikenkyu* also involves researching about scope and sequence of curriculum and anticipating student responses.

Kyozaikenkyu has been linked to lesson study as well as day-to-day teacher planning for Japanese teachers. Watanabe et al. (2008) gives an example of lesson study helping Japanese teachers in everyday lessons: "one way lesson study contributes to the improvement of everyday instruction is through *kyozaikenkyu*" (Watanabe, Takahashi, & Yoshida, 2008, p. 133). In later chapters, I will discuss how most of the research on *kyozaikenkyu* is from the perspective of lesson study. However, there are researchers that talk about the effects of *kyozaikenkyu* in everyday teaching. Because of my interest in making high quality lessons, that is to mimic those lessons of the Japanese educators, delving further into this concept will help me achieve my goals. In addition, I believe that through a better understanding of *kyozaikenkyu,* teachers in the United States as well as other places in the world, can be better equipped to achieve high quality instruction in their lessons.

This study investigates what activities are included as well as the goals of day-to-day *kyozaikenkyu*. Also, because k*yozaikenkyu* is a central part of Japanese educator's planning process, the study further explores how day-to-day *kyozaikenkyu* is viewed and defined in the eyes of the Japanese educators that use it. This study also examines the culture that provides opportunities for these educators to gain knowledge of *kyozaikenkyu* and how to implement it.

Data and responses were gathered through an ethnographic study with the Japanese educators who do *kyozaikenkyu* every day. This study explains what Japanese teachers do in their day-to-day *kyozaikenkyu* and, therefore, adds to the field of mathematics education's understanding of what typifies the high-quality instruction provided in Japan.

CHAPTER 2: THEORETICAL FRAMEWORK

Kyozaikenkyu is a cultural activity that the Japanese educators seem to grasp onto as they begin their career. To understand this phenomenon within this specific culture, I first identified how a regular lesson in Japan is structured. Through understanding the lesson structure of Japanese lessons, I determined why teachers do certain activities during their *kyozaikenkyu*, and I then identified my beliefs as a teacher in the United States. This allowed me to situate why I find some activities important and crucial to the planning practices. Knowing my beliefs also helped build a stronger case as to why I wanted to research Japanese classrooms because my lessons were trying to imitate Japanese lessons. I also identified my current understanding of *kyozaikenkyu* to the reader to understand how I am building upon a description or idea that is already in place.

Structure of Japanese Lessons

Looking more in depth into Stigler and Hiebert's (1999) definition of *high quality instruction* we can define *structured problem solving.* Many Japanese lessons in the elementary schools and the middle schools tend to follow this same structure. The structured problem-solving approach has been explained to have the following sequence of five activities: reviewing the previous lesson, presenting the problem for the day, students working individually or in groups, discussing the solution methods, and highlighting and summarizing the major points. Akihiko Takahashi (2006) provides this figure to help better explain the structured problem-solving approach.
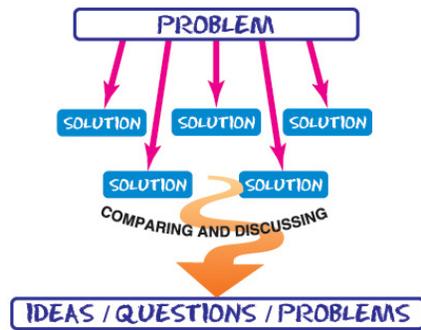
Taken from Takahashi (2006)

Figure 1. A Depiction of Structured Problem Solving

The first step in structured problem solving is going to be the posing of the problem. This is Stigler & Hiebert's second step; however, the review section of their process tends to not be considered part of the problem-solving approach. After the problem is posed then students are given time to work on the problem either individually or in groups; which is an example of Figure 1 where the different solutions are starting to appear. The teacher then will discuss the different solutions and tie them together to help the students understand where the other methods came from, then the last part of the structured problem-solving approach is going to be what the Japanese call the *matome*, or the conclusion. This is where the teacher makes a final and careful comment on the lesson and presented solutions (Shimizu, 2007). It is also known as the "summing up" stage of the lesson. This then is repeated in most lessons that the Japanese educators teach to their students.

There are many aspects that are desirable when looking at the structured problem-solving approach. For example, the students can take ownership of solution methods and the students are able to use their previous knowledge to build new knowledge. Additionally, knowing where the students are mathematically will be easier to observe during the students' work session or during the group presentations, etc. However, there are two main reasons that the Japanese educators

teach from this structured problem-solving approach: First, to create interest in mathematics among the students, and second, to stimulate creative mathematical activity. This follows the renowned book "Adding It Up" (Kilpatrick, Swafford, & Findell, 2001) when the five strands of proficiency are introduced. The strand that this directly correlates with is having a productive disposition, which is necessary for students to become successful in mathematics. Through this structured problem-solving style of teaching, Japanese teachers can achieve *high quality instruction* according to Stigler and Hiebert's definition.

The teacher's tools and actions in *structured problem solving* allowing Japanese educators to achieve *high quality instruction* frequently include: **Hatsumon, kikan-shido, neriage, matome,* ensuring student "ownership", and *bansho* (Shimizu, 2007). The *hatsumon* is a key question for provoking student thinking during the lesson; however, later on in the results section there is evidence provided that the definition of *hatsumon* varies among the Japanese educators. Usually a lesson will have multiple *hatsumon* to provoke student thinking along with other support questions to explore and develop the student's ideas that are produced because of the *hatsumon*.

The *kikan-shido* is interpreted as *instruction at students' desk.* This role includes the teacher roaming the room carefully scanning student work looking for the expected student responses they have previously studied. This step allows teachers to take note of several different approaches to the problem that the students present to the whole class.
The next role that teachers have during a structured problem-solving approach is the

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*Due to the nature of this thesis, Japanese words will often be used in their untranslated form. A glossary will be provided in the appendix for clarification and remembrance purposes.

neriage. The *neriage* is the term for describing the whole class discussion. This role implies more than choral responses or ask-answer style questioning classroom. There is the implication that it is student work that is shown. The order that the teacher calls the students to the board is of utmost importance because it will allow for students to make the mathematical connections from their methods to the material that will be discussed later. Incorrect responses are sometimes chosen if the teacher feels that it will be beneficial for the student learning. The term *neriage* is usually used as a term for "polishing up." The role of the teacher is to help "polish up" the student's methods and ideas (Shimizu, 1999; Shimizu 2007).

Ensuring the student's "ownership" during the lesson is an important role in structured problem solving because it allows the students to gain that positive mathematical disposition that was previously mentioned. Teachers often keep the student's name attached to their presented method on the chalkboard to help with ensuring that ownership.

Bansho is a teacher's skill that translates to the ability to use the chalkboard to help promote students' thought processes. Japanese teachers organize their work on the chalkboard during their lesson plan. They attempt to not erase anything on the chalkboard during the class, therefore giving the impression that everything written on the chalkboard is worth writing down.

These are some of the roles that Japanese teachers agree on while teaching from a structured problem-solving method. The Japanese teachers can achieve a high-quality level of instruction through the form of their classroom and the teacher's roles during a structured problem-solving approach (Stigler & Hiebert, 1999; Corey et al., 2010).

In the Japanese educational system, newer teachers are given an experienced teacher to be their mentor. Through these apprentice and mentor relationships, instruction about how to conduct lesson planning, how to teach lessons, and what the quality of lessons should be are all

taught and learned.   Newer teachers are also invited to be in lesson study groups, where there are more experienced teachers giving their input on instruction for a specific lesson. Topics that are covered during lesson study can include, but are not limited to: lesson planning, *kyozaikenkyu*, lesson plan creation, pace of the lesson, chalkboard presentation, topics that correlate, and different ways to introduce a topic. Not every activity is covered in each lesson study, but they are discussed more and more as the group meets. Lesson study, which resembles a teacher workshop, is where teachers learn and begin to form their understanding of *kyozaikenkyu*. That is, individual teachers have formed different understandings of *kyozaikenkyu* based on their mentor teacher and their experiences in lesson study groups.

Lesson study. The research about *kyozaikenkyu* is found in articles about lessons study; therefore, to help situate the descriptions of *kyozaikenkyu*, I will describe lesson study. Lesson study is both a method for in-service teacher professional development (Fujii, 2013), and a pre-service teacher instruction tool (Shimizu, 1999). Lesson study does not follow a set of rules or mandated items that need to occur, as it is more of a cultural activity (Takahashi, 2006). It takes on many different forms depending on which group of teachers are holding the lesson study, as well as the main goals behind the lesson study. Although there are differences in the appearances of the different lessons study groups that are held, the purpose of the lesson study is similar in nature.

When "The Teaching Gap" (Stigler & Hiebert, 1999) introduced lesson study there was little written about it in English; however, they could grasp a sense of the purpose behind lesson study. There is an eight-step process of lesson study that Stigler & Hiebert (1999) outline in "The Teaching Gap". That process includes defining the problem, planning the lesson, teaching

the lesson, evaluating the lesson and reflecting on its effect, revising the lesson, teaching the

revised lesson, evaluating and reflecting again, and sharing the results.

Other researchers have similar lists and ideas (see Figure 2).

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        ┌─────────────────────┐
   ⟳    │ 1. Study Curriculum │    ⟱
        │  and Formulate Goals│
        └─────────────────────┘

┌──────────────┐              ┌──────────────┐
│ 4. Reflect   │              │ 2. Plan      │
└──────────────┘              └──────────────┘

        ┌─────────────────────┐
   ⟰    │ 3. Conduct Research │    ⟲
        │       Lesson        │
        └─────────────────────┘
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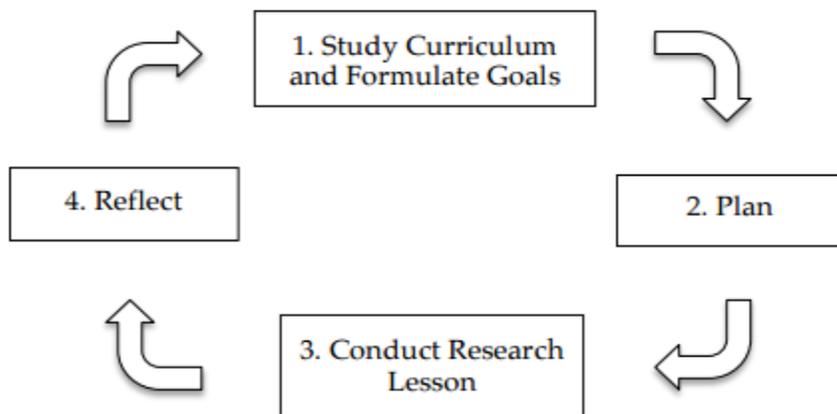
Taken from Fujii (2013)

Figure 2. The Lesson Study Cycle

 The list is rather extensive, and offers an explanation as to why the lesson study groups can take

anywhere from a couple of months to a year depending on the group of educators who are

conducting the lesson study.

Lesson study is more than the improvement of a single lesson, it is also considered to

help educators improve their mathematical instruction (Watanabe, Takahashi, & Yoshida, 2008).

Teachers that are participating in these lesson study groups need to plan their own lessons for the

rest of the lessons that occur in the time span in which the lesson study is being held. Therefore,

more than the research lesson is talked about in these meetings. Scope and sequence, best

teaching practices and best methods of solving different problems are also discussed.

The lesson study process is divided into three main categories and could be repeated as

seen in Figure 2; however, those repetitions are optional. The three main categories are: 1.

collaboratively planning the research lesson, 2. seeing the research lesson in action, 3. discussing

the research lesson. Many countries are trying to implement research based lesson study; however, there are many aspects of lesson study that are not transferring (Fujii, 2013). One such aspect of lesson study is *kyozaikenkyu*. This leads to an inefficient use of lesson study and is not yielding the same results that are seen in Japanese classrooms (Watanabe, Takahashi, & Yoshida, 2008). *Kyozaikenkyu* is part of the planning phase of lesson study and is an essential component of holding a successful lesson study (Takahashi & Yoshida, 2004).

Upon further investigation, researchers explain that *kyozaikenkyu* should also be engaged in everyday by teachers, not just in a lesson study context (Watanabe, Takahashi, and Yoshida, 2008). Watanabe, Takahashi, and Yoshida go on to further explain that if teachers do not engage in *kyozaikenkyu* every day then a high-quality curriculum could be lowered to the level of being taught in a procedural way (2008, p. 141). This statement uncovers one of the problems I encountered teaching from a structured problem-solving approach. To resist lowering the quality of my lessons I should be engaging in *kyozaikenkyu* every day. My research question then slightly transforms into, "What is "every-day" *kyozaikenkyu*?"

Based on the variance amongst the descriptions of *kyozaikenkyu* as it relates to lesson study, I expected the descriptions and ideas of everyday *kyozaikenkyu* to have the same spread of ideas as lesson study *kyozaikenkyu*.

My Beliefs on Teaching in the United States

I already detailed my experiences as a teacher and why I wanted to research *kyozaikenkyu* in the rationale; however, this section will focus on my beliefs as a teacher in the United States. From the time that I was a pre-service teacher, I learned about the structured problem-solving approach in current Japanese mathematics. I student taught for a teacher who was very skilled at this approach and encouraged me and others to learn why he taught through this approach. I was

surprised at the level of thinking that the students were operating while in his classroom. Students could produce creative and efficient methods to solve difficult mathematical problems while collaborating with their peers using mathematical language. It was unlike any classroom I had ever experienced.

I went to high school in Utah where I was put on the accelerated path in mathematics. I was taking Calculus my junior year in high school and was successful. My mathematical classrooms all followed a "United States Pattern" of teaching. Stigler and Hiebert (2001), in their book "The Teaching Gap", describe what happens generally in United States lessons. Lessons in the United States tend to follow this pattern: reviewing previous material, demonstrating how to solve the problems for the day, practicing, correcting seatwork and assigning homework. I found myself, as a student, trying to read the textbook if I did not understand what was currently being taught. The need for an instructor was minor in comparison to the structured problem-solving approach. This method proved successful for me as a student because I exceled in memorizing facts. However, it was not until my college mathematical career that I truly understood mathematics from a conceptual perspective.

When I first started teaching, I was set on using the structured problem-solving approach to teach my students. Although this approach differs from the standard United States approach that I had experienced, I felt that it was necessary to help my students gain conceptual as well as procedural understanding of the required mathematics. While I was a student teacher, I had been a part of a structured problem-solving approach classroom for about two months and I was able to work closely with my mentor teacher to help me develop a classroom that would be successful in such an approach. After trying this style for a few years of teaching, I found it difficult and I felt that my students were not gaining that conceptual knowledge. Students were going through

the motions of a structured problem-solving approach classroom, however the creativity and efficient methods that I had observed in other classrooms were not apparent in mine. Something was wrong and I did not know what it was, therefore I started to revert to what I was comfortable with, which was the same approach to teaching as I was taught in high school. I still had doubts as to whether my students truly understood the mathematics at the level that I thought they should, but as a teacher, I put the responsibility on them instead of taking it onto myself.

I eventually concluded that there were steps along the way in the structured problem-solving approach that I was missing. There had to be something that my mentor teacher and other successful teachers were doing to help make this structured problem-solving approach successful. I am not alone in my unsuccessful attempts to recreate the structured problem-solving style of classroom. Attempts to recreate this structured problem-solving teaching style have been attempted in the United States and Australia. However, these attempts have been unsuccessful because certain aspects of the structured problem-solving approach are ignored or not done skillfully (Fujii, 2013; Takahashi et al., 2005; Doig, Groves, & Fujii, 2011). Based on the negative results in other countries, Japanese educators must be participating or conducting some activity that makes them so proficient at constructing high quality lessons.

Many of the studies regarding Japanese teachers' effectiveness contribute at least some of their efficacy to their participation in lesson study. Lesson study is a collaboration of teachers that are all working on the same lesson to improve the quality of the lesson and their skills as teachers in various ways. It comprises three main steps, which are collaboratively planning the study lesson, seeing the lesson study in action, and discussing the study lesson (Fernandez & Yoshida, 2012). Many countries are trying to implement research based lesson study; however, there are many aspects of lesson study that are not transferring (Fujii, 2013). One such aspect of

lesson study is *kyozaikenkyu*. This leads to an inefficient use of lesson study and is not yielding

the same results that are seen in Japanese classrooms (Watanabe, Takahashi, & Yoshida, 2008).

That is, one possible explanation for why I, as well as many others, have been unsuccessful in

implementing a structured problem-solving approach to teaching is because we are unable to

have *kyozaikenkyu* in the same way.

My Current Understanding of *Kyozaikenkyu*

The descriptions that are provided in the research for *kyozaikenkyu* are lacking cohesion,

and produce confusion instead of clarity. In the rationale, I showed the most polarizing

descriptions of *kyozaikenkyu*. While some researchers (Fujii, 2013) just use the direct translation

of *instructional materials research*, other researchers define *kyozaikenkyu* as, "Investigating

what kind of materials various textbooks use to teach this topic to students, and what research

suggests (if anything) about various methods for teaching the topic" (Takahashi, 2006). This

description hints at what *instructional materials* are, so it is still in line with the direct

translation. Other researchers define *kyozaikenkyu* to be a "two-phase" activity where "The first

(phase) is the study of materials that are already developed as *kyozai* (instructional materials).

The second (phase) is actually done to develop *kyozai* so that the main emphasis appears to be an

in-depth investigation of the particular subject matter" (Watanabe, Takahashi, & Yoshida, 2008).

The first phase of this description is in line with the other researcher's descriptions; however, the

second phase is a new idea that other researchers do not mention in their descriptions. One of

the older descriptions on *kyozaikenkyu* is from Shimizu (1999), who claims the following:

> "*Kyozaikenkyu* refers to the careful analysis of the topic in accordance with the
>
> objective(s) of the lesson. It includes analyses of the mathematical connections both
>
> among the current and previous topics (and forthcoming ones, in some cases) and within

the topic. Also included are the anticipation of students' approaches to the problem and

the planning of instructional activities based on the anticipated responses. (Shimizu,

1999)

Shimizu's (1999) description of *kyozaikenkyu* hints at an activity that implies so much more than

just investigating materials used for instruction, because there is the implication that teachers are

also learning about best teaching practices and anticipated student responses.

To try to understand which description I should attach my understanding, I asked

professionals in Japan about their descriptions of *kyozaikenkyu*. My Japanese colleagues were

surprised when they found out they had varying descriptions from each other. One particular

colleague, a professor at Saitama University in Japan, was so intrigued that he took a survey to

his mathematics education group and asked them to fill it out. The responses that he received

represented a wide range of interpretation of *kyozaikenkyu*. Some of the responses aligned more

towards the direct translation and others seemed to hint as aspects of Shimizu's (1999)

description. Some examples of responses that are closer to the direct translation include: "To

understand the essence of the teaching materials"; "To think about the interpretation of the

teaching materials and how to teach it"; "(To consider) what are teaching materials, what the

relation of the teaching materials are, and what connection with our life does the teaching

material have". These examples talk about trying to understand the teaching materials and how

to teach those materials. Other responses from Japanese teachers were different in nature with

respect to what they focus on during *kyozaikenkyu*. Some of these responses include: "Prepare

for the class by learning the content/subject by ourselves beforehand. Expect the reaction of the

students"; "What the title/topic and how to consist the flow of the class to make students

interested in the math and receive the power of the math"; "It is like advanced preparations for

well-planed guidelines to discern what ability the students could learn through the teaching materials". These responses are more focused on student thinking and ability rather than just the materials themselves.

My Japanese colleague was shocked to find out the extent of the differences among all the responses that he received, so he decided to write a paper about implicit abilities of teaching in Japan, where *kyozaikenkyu* was one of the three abilities referenced (Ninomiya & Corey, 2016). When asked to define *kyozaikenkyu*, Japanese teachers have a very difficult time defining *kyozaikenkyu* with specificity. Fujii remarked in one of his papers that "lesson study in Japan is like air. Lesson study is so natural that it is difficult for Japanese educators to identify it's critical and important features. This is true for researchers as well" (Fujii, 2013, p. 15). *Kyozaikenkyu* is also very natural for Japanese educators. Most of the educators asked in the survey have never been asked to describe or define *kyozaikenkyu*; therefore, it is similar to the task of describing what salt tastes like.

Researcher's descriptions and ideas about *kyozaikenkyu* range from studying the textbook to thinking about student thinking. These descriptions are all "components" of *kyozaikenkyu*, but they are all trying to envelop the idea of *kyozaikenkyu* from a different angle. The descriptions are all defining *kyozaikenkyu* in how it should be done during Lesson Study. Takahashi et al. (2005) makes the claim that, "Learning to conduct *kyozaikenkyu* will help U.S. practitioners implement lesson study in a deeper more sustainable way that impacts both teaching and learning" (p. 108).

Day-to-day *kyozaikenkyu*. Lesson study lessons are thought about in depth. The lesson study group spends months discussing and evaluating one lesson. This is beneficial to the Japanese teachers; however, Japanese teachers must be doing something to make their

instruction *high quality* on a day-to-day basis. Takahashi et al. (2005) claims, "ultimately,

teachers can transfer the investigative process (*kyozaikenkyu*) to their daily lesson planning,

albeit on a less rigorous level" (p. 107). That is, Japanese teachers can take what they learned

about *kyozaikenkyu* during lesson study and apply it into their own personal lesson preparations.

The fact that teachers have *kyozaikenkyu* every day is only briefly mentioned in the literature

(Takahashi et al., 2005; Watanabe, Takahashi, & Yoshida, 2008; Yoshida & Jackson, 2011).

Yoshida and Jackson (2011) wrote a chapter in a book titled, "Lesson Study Research and

Practice in Mathematics Education". In a book with five parts, and four chapters per part, only

one chapter is on the importance of *kyozaikenkyu*. The authors did mention that teachers

implement the practice of *kyozaikenkyu* in their daily planning practices; however, there are

many questions about day-to-day *kyozaikenkyu* that surface after this reading. For example, how

much less rigorous should day-to-day *kyozaikenkyu* be compared to *kyozaikenkyu* from a lesson

study perspective? Another question is, what other types of instructional materials are used?

And further, how are these materials used? How often do teachers use other instructional

materials besides a textbook?

Because these questions started to materialize while reading the literature on

kyozaikenkyu, I started to ask my Japanese colleagues about a more precise description or

example. However, Japanese educators have a hard time articulating what they think

kyozaikenkyu is, even though they claim to understand and conduct *kyozaikenkyu* on a regular

basis. In the lesson study process, there is a role called the "knowledgeable other", or in

Japanese, the *shidosha*. This role is for a person outside of the school, usually a visiting

professor, district supervisor, or an experienced teacher, to help support the lesson study process.

This "knowledgeable other" is someone who has expertise in the subject matter and in the lesson

study process (Watanabe & Wang-Iverson, 2005). The *shidosha* passes down information about *kyozaikenkyu* as well as any other aspect of lesson study that teachers would like to know more about. Therefore, in the United States, where lesson study is relatively new, the role of this "knowledgeable other" is hard to fill. Teachers in the United States are unable to pass down information because there is an unclear grasp of *kyozaikenkyu*. My research will help me become part of a community and learn from "knowledgeable others" to find commonalities among concepts and practices of day-to-day *kyozaikenkyu*. This will add clarity to the description of day-to-day *kyozaikenkyu*, and therefore will allow teachers to hold a more productive lesson study group, which will in turn allow for teachers to achieve high quality instruction.

CHAPTER 3: LITERATURE REVIEW

The literature that has been discussed in the Theoretical Framework is relating to the descriptions and introducing the idea of *kyozaikenkyu*. These descriptions came while an article was describing lesson study. In this chapter, I will look at literature describing the benefits of a structured problem-solving approach, as well as literature describing attempts to have successful lesson study in countries other than Japan. This literature will demonstrate the need for every day *kyozaikenkyu* in these countries.

There have been unsuccessful attempts to recreate a structured problem-solving approach in the United States as well as Australia (Doig, Groves, & Fujii, 2011). While they could replicate the form of the classroom, the principles that the Japanese teachers use to teach from a structured problem-solving perspective were not found. These principles include building mathematical understanding from student mathematical thinking, lesson preparation, and student intellectual engagement and student thinking (Jacobs & Morita, 2002; Corey et al., 2010).

One reason for success from structured problem solving is it enables Japanese teachers to help students build mathematical understanding from their own thinking (Jacobs & Morita 2002). Students are given ample time to build their own understandings of the *hatsumon*. Because students can work through the mathematics, they are able to understand other student's representations of the solution when they are presented. For students to build their own understanding from their thinking, teachers must know the scope and sequence of the unit while planning for the lesson. Through this scope and sequence, teachers then know what the students can accomplish before the lesson, and what knowledge they should be able to construct from the lesson.

Lesson planning becomes a crucial principle for teachers to achieve high quality of instruction during their lessons. Not only do the teachers need to know what knowledge the students have before the lesson and what knowledge they should construct from the lesson, but they also need to know what teaching styles and questions they should use to bridge the gaps between different topics covered in the unit. Teachers need to know of possible answers that students are going to derive to be able to properly organize the student thinking that appears in the lessons.

Student intellectual engagement is a very important factor in high quality lessons. In the Jacobs and Morita (2002) study, Japanese teachers observed a lesson taught by a teacher from the United States and another lesson taught by a Japanese teacher, and they were asked to give feedback as to why it was a good or poor lesson. Teachers from the United States were asked to complete the same task for the same lessons. Japanese teachers used student involvement as an indicator for a good lesson, while the teachers from the United States were more focused on classroom management issues.

Another example of this principle is from the Corey et al. (2010) study, in which coordinating teachers were giving advice to student teachers on the lesson plans they had prepared. The article quotes the coordinating teacher speaking to his student teacher about his lesson plan. He states, "Students won't use their head at all…what you are planning is just to kill the time" (Corey et al., 2010, p.451). The coordinating teacher was trying to explain that if the students are not going to be engaged intellectually then the lesson is meaningless.

Through the principles that underlie the structure of Japanese lessons, teachers can have the lesson reach its full potential for the students. Through careful planning, student intellectual

involvement, and being able to connect student mathematical understanding to student mathematical thinking, teachers can achieve a lesson that is considered high quality instruction.

Even though teachers outside have had a hard time implementing the structured problem-solving approach in their own classroom, there have been some successes. Lewis et al. (2011) found that Japanese teacher's manuals have two features that are found less often in their United States counterparts: anticipation of student thinking, and explicit rationale for pedagogical decisions (Lewis et al., 2011). These differences are key factors in their observations as to why lesson study groups in the United States were lacking rich discussions of mathematics and student mathematical thinking. Lewis and Perry (2013) later developed a study in which a materials packet was given out to lesson study groups that included student's challenges with the topic and learning experiences that could help the students overcome said challenges. They also included curriculum materials on the topic and tools to support their lesson study groups on that same topic. Anticipated student responses were included with an example of an experienced Japanese teacher teaching a lesson on the same topic to students from the United States. They found that lesson study groups that were given the materials packet showed improvement in their mathematical knowledge for the topic as well as increased student learning. The items given to teachers in the materials packet correlate with Shimizu's (1999) and Takahashi et al.'s description about *kyozaikenkyu*. Even though Lewis and Perry (2013) did not use the term *kyozaikenkyu,* they provided these lesson study groups a platform where *kyozaikenkyu* was partially done for them; consequently, they allowed these lesson study groups to improve their knowledge and student learning.

If teachers can create these packets for themselves that Lewis and Perry (2013) developed, then their knowledge for teaching mathematics will increase with student learning

during every lesson. When student learning is increased then the quality of the lesson has also increased. Therefore, the creation of these packets is *kyozaikenkyu*, or at least part of *kyozaikenkyu*.

Trying to find a better description of *kyozaikenkyu*, I contacted a colleague in Japan. Dr. Yoshii did his dissertation about the method of *kyozaikenkyu* with respect to mathematics education. In his dissertation, he uses two different approaches to *kyozaikenkyu* to describe patterns he found in his data. The first approach is teachers use the materials that they were given and make goals to help make that material powerful for the students. The second approach is teachers make goals for what they want their students to be able to accomplish and then find teaching materials that fit their needs" (Yoshii, 2015). Dr. Yoshii explained that this description of kyozaikenkyu is not original to his dissertation (Yoshii, Personal communication, 2016). This description of kyozaikenkyu is about the teachers' beliefs as they hold *kyozaikenkyu* instead of method of daily *kyozaikenkyu*.

CHAPTER 4: METHODS

From the descriptions and personal communications with current educators in Japan, *kyozaikenkyu* is a cultural activity that Japanese educators grasp onto as they begin their career. Since I wanted to further my understanding of this phenomenon (*kyozaikenkyu*) occurring among the specific culture of Japanese mathematics educators, I chose to use an ethnographic approach in my research. I took aspects of the ethnographic approach described by Eisenhart (1988) in my data collection process as well as my data analysis techniques. An ethnographic approach provided me with the opportunity to explore and experience how Japanese mathematics educators understand and practice *kyozaikenkyu*.

In this ethnographic study, I was the lens through which the data was interpreted. Therefore, the framework I developed situates my own understanding of *kyozaikenkyu* learned through literature and my pilot study, my beliefs about teaching, and my understanding about Japanese classroom progression and their lesson structure.

Pilot Study

I decided that a pilot study was needed because most of my information about daily *kyozaikenkyu* was coming from only one source in Japan. I wanted to ask a different colleague his opinions on this matter to see compare and contrast his opinions about daily *kyozaikenkyu* from my other colleague. The purpose of the pilot study was to gain a different perspective on daily kyozaikenkyu.

I gathered data from one colleague in Japan, who is currently a math teacher, about different aspects of *kyozaikenkyu*. I asked questions that asked him to describe daily *kyozaikenkyu*. There was no interview protocol for this interview, but the purpose of this

interview was trying to get my colleague to expound upon the aspects of daily *kyozaikenkyu* that he felt were important enough to share with me on our limited time frame.

Through the responses that I received during my pilot study I was able to glean a different perspective than I previously had. For example, my colleague was able to share a metaphor that he uses to describe why he does daily *kyozaikenkyu* and how daily *kyozaikenkyu* differs from purpose of *kyozaikenkyu* done for a research lesson. This metaphor was passed down to me from my colleague, who learned it from his mentor. He told me that *kyozaikenkyu* is like getting ready for cooking. Before you start cooking, a decision on what to cook must be made. When deciding what to cook, the people eating the meal must be taken into consideration. For example, my spouse does not enjoy seafood, so I will avoid buying seafood at the market if she is going to be eating the meal. Once a decision has been reached on what is going to be cooked, you must think about how it is going to be cooked. Then the tools and items used to cook it in such a manner must be produced or purchased to make cooking the meal a success. This metaphor really resonated with me because I realized why these teachers put in the preparation before they teach a lesson in the structured problem-solving format. I could decide that I want to cook eggs, but if I start cooking without first preparing, several things could go wrong: from overcooking the eggs, to finding out that there are no eggs in the refrigerator. Without proper preparation in teaching a structured problem-solving style lesson, many things could go awry. This can include, but not encompass, not properly tying in the subject to the student's previous knowledge, and not having the proper problem to pose for the students to solve.

This metaphor depicts the drive behind Japanese teachers desire to teach good lessons that will provide their students with a good experience in mathematics. I also learned that

kyozaikenkyu is more than simple preparation for a lesson. There was a lot more depth and meaning talked about in that metaphor than simple meal planning. The effort that goes into coming up with what meal to make before the actual preparation begins is very important here.

One more benefit from my pilot study was I figured out how to ask questions that elicited the responses that were beneficial to my study. I also realized what questions did not elicit any type of response and therefore should not be asked. This process helped finalize my interview protocol when thinking about what kinds of questions I should ask the participants to gain the most from their responses.

Participants

I interviewed ten Japanese educators considered by their colleagues to be highly motivated and very good teachers. Some of the teachers that were selected are collaborators with my Japanese colleagues in Saitama, while others are from Osaka and Hokkaido. Osaka and Hokkaido are different prefectures where the culture of teaching and culture in general is different than other areas of Japan.

I recruited Participants for this study through my colleagues in Japan. I communicated with my colleagues before I went to Japan that I would like to interview teachers that taught at a junior high school with various years of experience. I also expressed the desire to interview teachers from different areas in Japan. The last factor that I implored my colleagues to consider when helping gather participants for the study was that the participants should have had different mentor teachers as well as different work circles. Work circles in Japan would include the university that they attended as well as lesson study groups. These factors would help provide a variety of participants.

The following table provides information about the participants that I interviewed. It provides the participants name, gender, years of experience, what prefecture they come from, what type of school they teach at (affiliated or public), and whether they have furthered their education since becoming a teacher.

Table 1 *Description of Participants*

Name	Gender	Experience	Prefecture	School Type	Continuing Education
Matsumoto	M	3 years	Saitama	Public	Currently Attending
Horiguchi	M	11 years	Saitama	Public	Currently Attending
Kawasaki	M	8 years	Saitama	Affiliated	No
Wakabayashi	F	5 years	Hokkaido	Public	No
Yamasaki	M	19 years	Hokkaido	Affiliated	No
Nagamine	M	5 years	Saitama	Public	No
Shigehara	M	15 years	Hokkaido	Both	Yes
Nakamura	M	8 Years	Saitama	Affiliated	No
Minami	F	10 years	Saitama	Public	No
Yatsushiro	M	3 Years	Osaka	University	Yes
*Note all names are pseudonyms.					

I interviewed teachers at various stages in career and with different beliefs on planning and *kyozaikenkyu* that provided the opportunity for several different ideologies to come forth. Interviewing/observing/participating with a variety of teachers allowed me to see their descriptions of *kyozaikenkyu* and the activities they hold while participating in *kyozaikenkyu*.

One of my data collection methods was observation. Since I am the lens through which the responses are interpreted, I need to expound on some personal ideals that might not be prevalent in a typical Japanese lesson. Looking at a typical American lesson from "The Teaching Gap" (Stigler & Hiebert, 1999), there are profound differences from the typical Japanese lesson. I have been taught from an alternative method in the United States which was elaborated upon during the literature review. I also have a background and understanding of the Japanese culture and language. Using this background, I collected data about *kyozaikenkyu* in Japan with a variety of Japanese mathematics educators.

Data Collection

Using the ethnographic model of collecting data in Eisenhart (1988), I collected data with two main methods: observation and interviews. Due to lack of time, I was not fully able to immerse myself in a participant observation, so the observation method was modified to a strict observation role. Additional data was collected through the collection of artifacts and researcher introspection.

Interviews. Interviews are the primary source of data. In the interviews, I questioned the participants about their views on *kyozaikenkyu* and provided an opportunity for the participants to give examples or expound upon their thoughts. Their examples helped me organize my data into categories to situate how these teachers view *kyozaikenkyu*. I interviewed the participants with a semi-structured interview that allowed them to expand on those statements that were interesting or surprising. The interview questions encouraged participants to elaborate on how they define *kyozaikenkyu*, the purpose of *kyozaikenkyu*, and how they implement *kyozaikenkyu* in their daily lessons. The complete interview protocol can be found in Appendix C.

When asked "what is *kyozaikenkyu*?", my Japanese colleagues had a hard time putting their thoughts and ideas into words. Consequently, I provided the participants an opportunity to expound on their answers. Thus, to help answer my research question of "what is daily *kyozaikenkyu?*", I asked for specific examples of their beliefs and implementation of *kyozaikenkyu*. Through asking for specific examples, I determined where participants placed value; therefore, helping guide a formation of a description of *kyozaikenkyu*.

Observations. During my stay in Japan, I had the opportunity of following two current Japanese educators to work and observing their everyday planning routines. They were students at Saitama University assigned to teach a lesson at the affiliated junior high school. I observed their process of *kyozaikenkyu* for teaching this lesson. Throughout this activity, I took notes on things that intrigued or confused me and asked for clarification about those activities through questions and other informal conversations. I treated this observation like a "think aloud" where the Japanese educator will explain what he is thinking while holding *kyozaikenkyu*. My observations allowed me to situate myself on the goals and flow of a day-to-day *kyozaikenkyu* that occurs during an everyday lesson.   In my field notes, I looked for all things related to a teacher's everyday *kyozaikenkyu*. Some of those items included conversations held with other educators, how a textbook is used, what other materials are used besides a textbook or a teacher's edition of a textbook, etc.

Additional methods. In addition to the two aforementioned methods, I also collected data in additional ways that are important in an ethnographic research (Eisenhart, 1988), namely, the collection of artifacts and researcher introspection. The collection of artifacts helped in portraying a better understanding of *kyozaikenkyu* than if I would have only relayed personal experiences. Therefore, I obtained any type of "kyozai" or instructional materials that were

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developed during my time in Japan, and some that were developed before. These artifacts

include books containing lesson plans that are products of a completed lesson study, books that

include problems for teachers to choose and teach from, and other books that help improve

teaching. I looked for textbooks being used, notebooks, and any other physical item of value to

the *kyozaikenkyu* process. The artifacts add validity to my study because I am relying on

personal experiences, personal translation, and interviews of which I am the interviewer to gather

data. Through artifacts, I can partially remove myself from the findings and elaborate on the

results found during my study.

The other method I used is researcher introspection. Since my time was limited in Japan,

I did not undergo a full Ethnographic study. However, through keeping a journal during my time

spent there among these Japanese educators, I recorded my own personal thoughts and ideas on

kyozaikenkyu while fresh in my mind. I recorded how I was treated among the Japanese

educators. This helped determine if I was being treated as a true apprentice of learning from a

master about *kyozaikenkyu* and the activities therein. For example, when I taught a lesson in the

affiliated school, I was treated like the other Japanese teachers during the post-teaching meeting.

Coding and Analysis

This section describes the process that I went through in order to organize and make

sense of my data. The final codes are described more in depth in Chapter 5: Results.

My first pass through the data, I started to code the data I received from interviews and

observations through an open coding approach. When coding, I separated comments and

responses into categories that are similar in nature. I used the following categories:

1. Statements that identify the purposes or goals of *kyozaikenkyu* according to the
   teacher

2. Statements that identify what activities the educators perform during *kyozaikenkyu*

3. Statements that identify how the practice of *kyozaikenkyu* influences their teaching

4. Statements that identify how *kyozaikenkyu* for a research lesson differed from the *kyozaikenkyu* done for a daily lesson

5. Statements that indicated how teachers learned how to hold *kyozaikenkyu*

These are the categories that I solidified during my pilot study. During this first pass of analyzing my data, I eliminated the code "looking for statements and examples of how *kyozaikenkyu* influences teaching". Teachers would respond with statements such as, "Without doing *kyozaikenkyu*, I would not be able to teach" and "I would be a mess teaching if I didn't do *kyozaikenkyu*." All ten of the teachers gave statements that they needed *kyozaikenkyu* to teach. I am unsure if the translation of the question I wanted to ask was incorrect or if teachers were unable to explain how *kyozaikenkyu* influences their teaching, but the statements that were provided only alluded to the fact that *kyozaikenkyu* is important without going into detail. I also found that the "activities" code was directly linked with the "purposes" code and I decided to make the "activities" code a subset of the "purposes" code. Also during this pass, I found that how teachers learned the process of holding *kyozaikenkyu* was unimportant in trying to describe the process of *kyozaikenkyu,* and therefore beyond the scope of my study. Thus, I did not use the "learning *kyozaikenkyu*" category in this study.

I noticed that teachers were split in describing the reasons why they were doing certain activities. I decided to ask a professor I met while I was in Japan if he had a similar experience with this, and he responded with, "There are two ways that teachers approach *kyozaikenkyu*. The first approach is teachers use the materials that they were given and make goals to help make that material powerful for the students. The second approach is teachers make goals for what they

want their students to be able to accomplish and then find teaching materials that fit their needs" (Yoshii, Personal Communication, 2016). I decided that during my second pass I would code statements made by teachers to see if they fit these categories.

During my second pass of coding the data, I was very happy that my codes I had developed were substantial enough to have a sufficient amount of evidences in each of them. I coded instances included in "purposes", "two different approaches to *kyozaikenkyu*", and "differences between lesson study and daily *kyozaikenkyu*".

I then made my third pass through the data. During this pass, I went through all instances titled "activities" and then wrote a sentence explaining what those activities are. I noticed that these activities seemed to be directly influenced by the structured problem-solving approach (Stigler & Hiebert, 1999). Therefore, I developed sub-categories for the "activities" instances to organize them. They are: mondai, hatsumon, goals, matome (summary), and the unit plan. During my fourth pass through the data, I specifically looked at the instances titled "two different approaches to *kyozaikenkyu*". I tried to split the teachers into the two categories talked about by Dr. Yoshii to see if his description fit what I had found. I searched for similarities and differences in these statements. Through analyzing these statements, I developed the sub-categories of "student driven approach" and "content driven approach". I then made a fifth pass through the data to look more in depth at the statements and ideas behind the student driven approach to develop a description. Here I also developed a description of the content driven approach.

The sixth pass through the data I looked at the category code of "differences between lesson study and daily *kyozaikenkyu*". I grouped similar statements in the "differences between lesson study and daily" category to create sub codes. These sub codes that fit into the data were

the depth of lesson study's *kyozaikenkyu*, the representations of the teachers thinking for

kyozaikenkyu, and lesson study driven by a theme.

Overall there were six main passes through the data in which I developed my codes and

sub-codes for analysis.

CHAPTER 5: RESULTS

Describing my experiences and newfound ideas about defining daily *kyozaikenkyu* reminds me of Millroy's (1991) statement that she feels summing up her results is an "attempt to describe the indescribable." Even though I have formulated more questions than answers regarding Japanese teacher's planning practices and teaching methods, I do feel that I have been able to gain some insight into the practice of daily *kyozaikenkyu*.

Through coding the interviews, my notes and journal, and artifacts that I have collected, I found that *kyozaikenkyu* is a complicated process thought about differently from many perspectives. Teachers use this process to prepare their lessons to teach from a structured problem-solving approach (Stigler & Hiebert, 1999). Three main ideas have surfaced as I have been analyzing the gathered data to better understand daily *kyozaikenkyu*. They are:

1. The main purpose of daily *kyozaikenkyu* among math teachers and professors in Japan.
2. Two general forms of daily *kyozaikenkyu,* and how teachers normally gravitate toward one form.
3. The differences between daily *kyozaikenkyu* and *kyozaikenkyu* done for a research lesson.

As I focused on these three areas, I gained some insight as to what teachers do during *kyozaikenkyu*, how teachers feel about *kyozaikenkyu*, and the importance of *kyozaikenkyu*. Therefore, this brought me to formulate my own understanding about daily *kyozaikenkyu*.

Purposes of Daily Kyozaikenkyu

"Without doing kyozaikenkyu you are not teaching a lesson; in other words, your lesson had no meaning without properly preparing for it" (Mr. Kawasaki)

The above quotation came from one of the first teachers I interviewed. I questioned him about what a lesson would look like if a teacher did not do *kyozaikenkyu* for that lesson and his response was shocking. Overall, if the lesson does not have meaning and is not well prepared, then the teachers assume it would be a better use of time to not teach that lesson. In my notebook, I remarked on how the teachers were taken back by that question more than any other. It seemed unfathomable to them that anyone could teach a worthwhile lesson without *kyozaikenkyu*. From this question, I gained insight into the importance of daily *kyozaikenkyu* as well as some insight as to what they perceived as the main purpose of daily *kyozaikenkyu*. Some of the purposes of daily *kyozaikenkyu* that I could assemble are:

1. Lesson preparation (for example: lesson goals, lesson sequencing, etc.)
2. Improving understanding of mathematics
3. Improving one's craft of teaching

Lesson preparation. Lesson preparation includes a broad category of activities beyond *kyozaikenkyu*; however, there are many specific things that teachers do to prepare for their lessons. Mr. Nakamura, when asked the question of teaching without doing *kyozaikenkyu* for that lesson responded, "I wouldn't be able to teach. Bare minimum I *have* to do three things: confirm the lesson activities order for the day; what kind of problem am I going to use, and go over in my mind what I want the hour to look like." When Mr. Nakamura mentions lesson activities order, he is talking about activities that directly correlate with the *mondai*, the *hatsumon*, and the general flow of the lesson.

Mr. Nakamura's statement stood out in a couple of different ways. First, he emphasized that without *kyozaikenkyu,* he would struggle to teach. He continues by sharing that the two most important aspects are the sequence of the lesson and the goal of the lesson. When

discussing lesson sequence, he is referring to the structured problem-solving approach that was described by Stigler & Hiebert (1999), and then expounded upon by Takahashi's (2006) figure mentioned in the framework. Earlier, we talked about the sequence of structured problem solving in five activities: reviewing the previous lesson, presenting the problem for the day, students working individually or in groups, discussing the solution methods, and highlighting and summarizing the major points (Stigler & Hiebert, 1999). Akihiko Takahashi's (2006) figure of structured problem-solving approach, *figure 1.,* is a great way to describe the kind of work that teachers said they do during daily *kyozaikenkyu.*

The main components teachers prepare during *kyozaikenkyu* are: 1) the main problem, often thought as a lesson task in the United States, given to students to get them to think about the mathematics (*mondai*). 2) The thought provoking questions to help students think about the mathematics (*hatsumon*). 3) The summary of the lesson (*matome*). 4) Goals for the lesson (*kadai*). 5) The plan for the entire unit.

Mondai. Teachers select the problem for the day in different ways. Most teachers will turn to the textbook used for their classes and choose the problem selected for them. Others will read other published textbooks and determine differences from the problem found in their classroom textbook. In Japan, there are only seven textbooks published for all junior high mathematics. It is worthwhile to note that Japanese textbooks in the elementary and middle school levels, contain a structured problem-solving approach to teaching mathematics. Teachers will sometimes modify their approach to the problem, or change the problem itself to fit the needs of their students. Some teachers find problems that occur in everyday life that fit their lesson goals for that day. One teacher told me how he chooses problems for his classroom; he said, "I always carry a digital camera with me wherever I go. That way if I see something that

relates to my lessons I can take a picture. For example, I recently started taking pictures of the manholes that I see around the city; in Japan, the manholes are very beautiful and differ depending on the county they are in. I don't know if I will use them or not, but I could if I wanted to".

There are also some materials available in bookstores that have been published by university professors or current teachers containing sample problems used in these same types of lessons. There are also books that compiled previous lesson study lesson plans. I was given a book containing one hundred problems for junior high mathematics that related to ancient Japanese culture. There are magazines published monthly, like *Mathematics Teacher*, which include some sample problems and previous lesson study lessons. I asked teachers if they ever use the Internet, and three out of ten teachers interviewed told me they looked on the Internet occasionally. However, these teachers added a caveat about the internet that since anyone can post a lesson on the Internet, they were less likely to trust the materials found online.

Hatsumon. The next part of the structured problem-solving process is allowing students to work on the mathematics individually, and then often in groups. Again, we see that teachers prepare for this step in various ways. One teacher, Miss Minami, brought in her teacher's manual of the school textbook. In the manual, it had the problem found in the textbook, various ways for students to solve the problem, and a sample lesson sequence. A sample lesson sequence is the order and activities of a lesson taught from a structured problem-solving approach. She explained that she always goes through the teacher's manual and then determines if she needs to look at other potential answers her students may develop. Another teacher, Mr. Horiguchi, states, "I ask myself 'what is the value of the materials that I already have?' then I think about the questions that I can ask to get the most value." Both teachers are using materials

given in the textbook; however, they are looking to make the *mondai* of their lessons high quality. Mr. Horiguchi states that questioning is one part of making the lesson high quality. The questions teachers ask are called the *hatsumon* of the lesson.

The *hatsumon* are thought-provoking questions that help guide students in achieving the lesson goals. When thinking about potential student work, some of the solution methods could be relevant to the lesson, but other solution methods might be a deterrent; therefore, the *hatsumon*, or important questions, are also made while determining student thinking.

Hatsumon have multiple purposes. For example, *hatsumon* can be used as an introduction to help the students begin to think about the problem. There are also supporting questions that teachers have prepared to ask students if they get stuck in their thinking to nudge them in the right direction, however, whether those types of questions can be considered *hatsumon* are debated. I observed one example, of a *hatsumon* in which the teacher asked the students to show their answers through algebra, graphically, and charts. The teacher then asked the question, "Which representation works the best for this *mondai*?" This would be considered *hatsumon* because it is a key question to help students progress in their mathematical understanding and make conclusions based on their thoughts. Another example of a *hatsumon* was in a lesson that I found that taught students about the golden ratio. The lesson asked the students to draw the perfect rectangle given a side length. All of the students started with the same side length then they chose the width that they thought created the perfect rectangle. They were then asked to find the ratio between the given length and their chosen width. With the class having their ratios decided they then made a scatterplot of the ratios on the blackboard. After the scatterplot was created the teacher then is supposed to ask the question, "Why are there two crests to this scatterplot?". This is a *hatsumon* for this lesson because the students are then

forced to think about the activity in a way that they may have not originally. A key factor in any use of the *hatsumon* is that the questions are thought provoking.

Mr. Nagamine explained that he had over twenty *hatsumon* in his lesson for the next day. I asked him if he would use them all and he said, "It depends on the student answers. There are *hatsumon* for students who are ahead, there are *hatsumon* to help push the students who are having a harder time understanding, and then there are the regular *hatsumon* to get everyone to think about the *mondai*." Therefore, the *hatsumon* are developed during *kyozaikenkyu* for Mr. Nagamine to be prepared to ask these questions in the moment they are needed. Another use for hatsumon is helping students understand how all presented solution methods are similar. This happens in the *neriage* section of the structured problem-solving approach. During this time, teachers will ask certain *hatsumon* to allow students to see benefits of different solution methods other than the one they chose. The *neriage* is this time where teachers make connections to other students' responses, which will be discussed in depth later. *Hatsumon* are used to help teachers in other sections of the structured problem-solving approach. They are used to pose the *mondai* to students, to help the students think about the mathematics more deeply or in a different direction, and used to knead all the ideas posed by students together to come up with an understanding during the *neriage*.

Matome (Summary). During coding, I ran into a contradiction of what I knew about the *matome*, or the summary section of the lesson. When I asked teachers what they prepare for while doing *kyozaikenkyu*, the *matome* was not mentioned often. In ten interviews, it was only mentioned in one instance; and this was after I asked a question specifically about the *matome*. I assumed that all parts of the structured problem-solving approach would be worked on evenly during *kyozaikenkyu*; however, the *matome*, which is a third of Takahashi's (2006) figure, is not

part of the daily *kyozaikenkyu* process. Due to this contradiction in my understanding, I asked

Dr. Ninomiya via Skype about why the *matome* would be omitted by these teachers when it

seems to be a crucial aspect of the structured problem-solving process. He explained, "The

matome is usually done with the lesson goals. If the teacher poses the goal in the beginning of

the lesson, then the *matome* is being able to answer the lesson goal" (Ninomiya, personal

communication, 3/17/17). That is, it is unnecessary to prepare for the *matome* because they have

already prepared the lesson goals. Dr. Ninomiya went on to say, "Depending on the teacher's

definition of *kyozaikenkyu*, the *matome* and *neriage* are not part of *kyozaikenkyu*; however, the

teachers are still doing things to prepare for them during *kyozaikenkyu*." This is a good

explanation of why teachers omitted the *matome* while talking about their daily *kyozaikenkyu*.

These three previous categories are about what happens during the class period; however,

there are other aspects of *kyozaikenkyu* that teachers must prepare that are not included in the

structured problem-solving approach description.

Goals. Making unit goals and lesson goals is a use for daily *kyozaikenkyu* that is

unmentioned in the structured problem-solving approach. Unit goals are normally created before

kyozaikenkyu is done on any lessons in that unit.

Lesson goals go hand in hand with a lesson's *kadai*, meaning that some teachers pose the

kadai to gain the lesson goal. When students obtain the lesson goal, they can solve the *kadai*.

During the interviews, I found that some teachers would use the word "lesson goal" instead of

"*kadai*" and other teachers would talk about the "*mondai*" as they would the "*kadai*". I first

thought my language skills were lacking in this area, but when I asked for clarification from my

mentor in Japan, he helped clarify the role of lesson goals, *kadai* and *mondai*. He explained:

"*Mondai* is a problem for students to solve. The *kadai* is something that the students

should gain through solving problems. Skills, knowledge, or mathematical ideas through

solving problems is the *kadai*. When students get the answer, the *mondai* is solved;

however, the real purpose or goal is not just getting the correct answer, but getting a

certain skill, knowledge or procedural understanding. That real purpose is the *kadai*"

(Ninomiya, personal communication, 3/2017).

Therefore, teachers use the time during *kyozaikenkyu* to make lesson goals, determine the *kadai*

of the lesson, and then pick which *mondai* will help the students achieve the *kadai*. Activities

that teachers do during *kyozaikenkyu* to accomplish these tasks will be examined more closely in

the following section of the results. Dr. Ninomiya gave another reason for not all the teachers

using the same terms. He explained that the *mondai*/*kadai* terminology is used commonly at the

university level among mathematics educators and teachers that work closely with them;

however, not all teachers know or use those words. Even though these teachers do not use the

same vocabulary, they still make lesson goals and find *mondai* beneficial for their students to

achieve those goals.

Although the lesson goals, the *kadai*, and the *matome* are talked about as different

sections in the structured problem-solving approach, they are very closely related. This affects

how teachers prepare for them during *kyozaikenkyu*. The lesson goal is usually expressed in a

statement, while the *kadai* is usually expressed as a question. The *matome* is opening an

opportunity for students to answer the *kadai* or lesson goal at the end of class. Therefore, if a

teacher prepares for the lesson goal and *kadai* during *kyozaikenkyu*, they will not have to prepare

for the *matome* because the plan for the *matome* is closely tied to the *kadai*.

Unit plan. The last aspect of the lesson planning section of *kyozaikenkyu* is an activity

that teachers normally do first when completing daily *kyozaikenkyu*. The unit plan is an essential

part of daily *kyozaikenkyu* because it shapes how teachers view their everyday lesson purposes.

Mr. Horiguchi explained, "Through the unit plan I am able to tell the importance of the

mathematics and I can decide the type of lessons that need to be taught. I can also determine the

relationship between the individual lessons, which allows me to see where I need to get to one

day and begin another". He uses the unit plan to think about individual lessons and how they

intertwine before he attempts preparing those individual lessons.

Nine out of the ten teachers interviewed start with the unit plan to get an overall picture

of what needs to be accomplished during that unit. One way that teachers get this overall picture

is looking at how students will use the mathematics further on in their mathematical careers. For

example, if one teacher was teaching a 7th grade algebra class, they would look at how students

will use the idea of factoring in future grades. Most teachers also look backwards and determine

what students should already know about the topic before teaching. They do this to avoid

teaching topics that students already know, while also learning the student's level so they can

know what kind of questions the students should be able to answer (For a sample unit plan see

Appendix B). Mr. Yatsushiro stated, "The unit plan is a wide view of how the lessons relate to

each other, and it allows me to think about how they will use the mathematics in the future".

The unit plan and *kyozaikenkyu* go hand in hand because without the unit plan, teachers

would have a hard time making goals and picking out a suitable *mondai* for their lessons. Often

teachers will develop individual daily goals during their unit plan to make sure that all the

lessons in the unit achieve the main goal. With a single goal in mind, teachers can maintain

focus and work on lessons that will drive the mathematics to the desired point. Often, teachers

follow the unit plan that is outlined in the textbook their school has selected. Among the seven different companies that produce textbooks at the junior high level, there is some variation in the order of the lessons; however, the overarching goals are the same to accommodate for teaching standards set by the Ministry of Education.

There are instances of teachers that vary from the standard unit plan set by the textbook. Most of these teachers are more experienced and know the prescribed order of the textbooks, but they feel comfortable altering the pacing according to their needs. These teachers were three out of ten teachers interviewed. They have all taught for longer than ten years, making them comfortable with knowing all the material that should be taught during the unit. All three of these teachers worked for a *fuzoku* school, or school affiliated with a university. They worked very closely with mathematics education professors of the affiliated universities. However, not all teachers from the *fuzoku* schools diverged from the unit plans given to them in the textbooks. Two of the teachers that followed the textbook closely were also from a *fuzoku* school.

One teacher describes his thoughts about developing a unit plan, saying, "I don't use the textbook to make my unit plan or unit plan goals. I make them myself, thinking about what I should teach and how I should teach it. It often depends on how I can get students to gain interest in this unit. Once I figure that out, I make my daily goals to achieve those larger goals that I set" (Mr. Yamaguchi). Here he says he is more concerned with ensuring his current students have interest in the mathematics and catering to their needs and desires than following the pattern laid out by the textbooks. Mr. Yamaguchi has been teaching for over thirty years and is very comfortable with the material. He knows what units are harder for students to understand and what units are easier; therefore, he can change his time constraints accordingly. Another teacher expounded on his process by saying, "I look at the previous year's notebook. It is a

notebook that for every lesson a student has written down notes for that class and that helps me know what I taught and more importantly what the students are learning from the lessons" (Mr. Yamasaki). Trusting a student to take notes seems unreliable; yet, these students are taught to take notes beginning in elementary school, and therefore the teachers prescribe a standard notetaking process for all students.

I asked about doing *kyozaikenkyu* for the unit plans and all interviewed teachers said that they absolutely spend time doing *kyozaikenkyu* for the unit. I had never heard about the importance of knowing the unit plan before doing everyday *kyozaikenkyu*. However, with a unit plan in place, everyday *kyozaikenkyu* has a purpose and a goal. Although the *kyozaikenkyu* for the unit plan is a completely different topic, it is strongly connected with daily *kyozaikenkyu*. The sample unit plan in Appendix B shows a result of doing *kyozaikenkyu* for the unit plan.

Improving understanding of mathematics. Japanese educators can improve their overall understanding of mathematics during *kyozaikenkyu*. This is done through increasing their own knowledge of mathematics and understanding student's current knowledge of mathematics.

Mathematical knowledge for teaching. Another purpose of daily *kyozaikenkyu* is to ensure teachers understand the mathematics well enough to facilitate a good *neriage* that includes possible questions and solutions that may develop from the lesson. I asked a teacher what would happen if he tried to teach without doing *kyozaikenkyu*. He responded, "Without doing *kyozaikenkyu*, you will end up teaching lies. For example, you might end up teaching them incorrect things" (Mr. Horiguchi). Part of the structured problem-solving approach is to show students multiple solution methods of the problems that have been posed. From *figure 1.*, it looks like there are many different solution methods and only one is decided on to be the method that the class is going to use; however, in most classrooms there are several solution methods

shown to the students and they can pick which method makes the most sense to them. For teachers to understand and notice these different solution methods, they often spend time making sure they know the mathematics themselves. One teacher, Mrs. Minami, explained, "The teacher's manual usually has multiple solutions to the same problems. I look through all of the solution techniques to make sure that I understand the mathematics". Mrs. Minami also determines the sequence the solution methods should be presented to the classroom, based on the students' current knowledge, as well as difficulty to explain and understand.

Because teachers often prepare for multiple possible solution methods from the students, teachers will often do mathematics during *kyozaikenkyu*. "Doing mathematics" consists of often asking the question, "Can I solve this in a different way?". Teachers often find themselves attaching to one solution method, which is normally the one that they learned. Trying to understand varying solution methods well enough to teach them may take research and figuring out themselves. Mr. Matsumoto stated, "I don't read books or magazines (during *kyozaikenkyu*), but if there is something that I don't understand then I try to learn it from outside sources". There are many resources that can help teachers think about the mathematics from a different perspective and possible alternate solutions. In Japanese book stores, there are entire sections on teaching mathematics. Some of the books founds in these sections are comprised of sample lesson plans that had been through a lesson study on a specific topic (Soma, personal communication, September 2016). These lesson plans were created by professors or experienced teachers and contain several solution methods developed during class or by themselves. Several of the teachers discussed these types of books when I asked them how they prepared for the possible student responses. Other teachers talked about keeping their own notes to keep track of unfamiliar solution methods that may have seen during one of their lessons.

Students' current knowledge. More than developing their own knowledge of the mathematics, teachers often research about the students' knowledge. The students' knowledge here refers to what the students should know about certain topics before coming into the class, as well as how the student is going to use the mathematics in future courses. Teachers usually complete this step while preparing the unit plan portion of *kyozaikenkyu*. Part of developing a unit plan is looking back at what students already know and where they need to be to succeed in future classrooms. Then goals are developed daily to fill in those gaps. This relates to everyday *kyozaikenkyu* because it directly affects what the lesson goals will be. It also allows teachers to think about possible solution methods that might surface because of the students' prior knowledge. Mr. Shigehara showed me different methods that he used to understand students' knowledge. He explained, "In the schools there is always a teacher preparation room. In this room, they have the textbooks from the company that we are using for all grades; we also have textbooks from other companies as well. Then I can look back at the unit plan and see the knowledge that they have and that they will need". Dr. Souma is a professor for the Sapporo University of Education in Asahikawa, Japan. I spoke with him in depth about this vertical alignment idea, and he showed me a couple of books that teachers can purchase at any bookstore that go through topic by topic and explain what students learn in each grade (Souma, personal communication, 2017).

Above are just some of the tools available to help teachers develop an understanding of where their students currently are and where they need to go. Through the knowledge teachers gain during this research, they are better able to develop good problems that will help guide their students to the lessons desired outcomes.

Improving the craft of teaching. The final purpose of daily *kyozaikenkyu* evident through the interviews is developing skills for the classroom. Teachers often use this time to develop their teaching skills or discover alternate methods that may benefit their classroom. Teachers do this in a variety of ways, some of which are:

1. Reading books/magazines that contain ideas and skills to improve teaching
2. Personal communication with mentor/experienced teachers
3. Personal journal reflection

Through these different approaches to improvement, teachers will use some time during *kyozaikenkyu* to develop and sharpen their teaching skills. Including this as a purpose of daily *kyozaikenkyu* fits within a broader description of *kyozaikenkyu*. Some teachers would not view improving their craft as part of their daily *kyozaikenkyu*.

Books/magazines. I previously discussed teachers using books or magazines to find a *mondai* for a specific lesson. During my clarification questions regarding books and magazines that the teachers used, I found that teachers also use them for their own professional development during their daily *kyozaikenkyu*. Mr. Nagamine explained how he uses this time during his daily *kyozaikenkyu*. He states, "This might not be related to mathematics, but lately I have been trying to study the way in which I speak while teaching. I felt like I really needed to study it after teaching some lessons. I felt in those lessons that my skills were insufficient in that area". When I asked him how he is learning about different methods of speaking, he mentioned various books that he bought and is reading during *kyozaikenkyu*. Mrs. Minami also explained that she reads a monthly magazine, not only to look at different interesting problems, but she explained, "The magazine provides different ways to ask questions. That is the aspect of the magazine that I

really focus on". Through learning these different ways to ask questions, or pose the *mondai*, Mrs. Minami is improving her craft of teaching. Mr. Nagamine tried to explain his thought process behind always trying to improve his craft of teaching when he stated, "The study of math is one thing, but I need to study how to *do* class as well. If the power of my speech is bad, then class will turn out poorly as well. I have been thinking about topics like this a lot lately". This statement shows teachers doing daily *kyozaikenkyu* have this "always improving" mentality of Japanese educators (Corey et al., 2010).

    Personal communication with mentor/experienced teachers. Teachers in Japan use improve their craft of teaching by communicating with peers and professors about various items from their lessons they are preparing. Mr. Matsumoto said, "When learning how to do *kyozaikenkyu*, I often asked the teachers with more experience to look over my work. They would provide feedback and give me advice how I can improve and let me know if I am doing things correctly". Even though he is more experienced now, he still confers with other teachers about his lesson plans. One experience that I had while in Japan was that I had the opportunity to teach a lesson to a room full of eighth grade Japanese students. During the preparation process for this lesson, I tried to incorporate many different aspects of *kyozaikenkyu* that I had been learning. I found myself asking Mr. Matsumoto and Mr. Horiguchi for help on different aspects in my lesson and I apologized for asking them so much. They told me it is normal to work with other teachers to receive valuable input. Before formal lesson plan meetings or lesson study meetings they have their fellow teacher look over their lesson plan and give feedback. From this experience, I became better prepared to have *kyozaikenkyu* for the next lesson that I was going to teach.

Ms. Wakabayashi introduced a different way that personal communication is used to improve her teaching. Often when doing *kyozaikenkyu* for a lesson, she prepares with another teacher (often from a different school, yet teaching the same grade and topic). She explained, "I will sometimes watch the other teacher to see how the lesson goes in their classroom. I then take notes on things that I need to make revisions on to improve the lesson". I asked her if this would be considered *kyozaikenkyu*, and she claimed that it was part of *kyozaikenkyu*. Through this process, she could tell if her *kyozaikenkyu* was good enough to prevent surprises form arising in the lesson. If there are a lot of revisions in the lesson, then the next time she holds *kyozaikenkyu,* she will make sure to be aware of those kinds of things, therefore, improving her ability to prepare for a lesson. Ms. Wakabayashi said she does not do this level of preparation for every single lesson she teaches, but as often as she has time. From a daily *kyozaikenkyu* perspective, this type of personal communication takes too much time to happen every day; but the benefits affect how a teacher holds daily *kyozaikenkyu*.

Personal journal reflection. The last method in which teachers may develop teaching skills is through a lesson journal. Teachers often write out their lesson plans in a notebook. Some teachers will then make notes about the lesson and different ideas of thinking that may have come up during the lesson. Often teachers will use their notes from previously taught lessons to help prepare for the next lesson. Ms. Wakabayashi takes the note-taking a step further and makes notes that she thinks students will make during the lesson. These notes include everything that she tries to get the students to learn and understand. She then asks a student for their notes at the end of class and makes a copy of it to compare. She hopes the students make notes similar to those she wrote down. Through this comparison process, she identifies where she needs to put more emphasis, and what students actually gained from the lesson. If the notes

are similar, she deems the lesson a success. If the notes are different, she uses her *kyozaikenkyu* time to discern the cause.

More about these personal note journals will be discussed later when talking about the differences between daily *kyozaikenkyu* and research lesson *kyozaikenkyu*.

Two Different Approaches or Perspectives about Kyozaikenkyu

Through coding the interviews and asking teachers about their habits and practices during *kyozaikenkyu*, two different methods or beliefs of *kyozaikenkyu* emerged. I use the word belief, because more than doing different activities from each other, it is their ideals and how they are going to accomplish their goals for *kyozaikenkyu* that vary. I found as I reviewed and analyzed interviews that teachers fell into the two categories that Yoshii (2015) explains in his dissertation. The first category in which Yoshii describes, teachers use the given materials to make the mathematics powerful for their students, I will refer to as the "Content Driven Approach". The second category, in which teachers make goals for their students then look for supporting tools, I will refer to as the "Student Driven Approach". The two main areas in *kyozaikenkyu* in which these two approaches differ are in the *mondai* of the lesson and the unit plan.

Method 1: A content driven approach. Teachers that take a content driven approach tend to be in their first years of teaching and/or have less contact with university professors. Contact with professors can take many forms such as participating in the same math circle or working closely during a lesson study. Some teachers take a year off from teaching and become graduate students that learn directly from the professor for a year (like a teacher on special assignment here in the United States). Those that have less contact such as this are more likely to take a content driven approach, but this is a phenomenon with insufficient evidence to support

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any claims as to an explanation; therefore, I am unable to explain why this is true but would like to delve further into this question in the future.

When content driven teachers approach their unit plan, they normally look at the one in their given textbook. Mr. Horiguchi states, "I look at what I am given and ask how I can make this powerful for the students". When I asked him how he built his unit plan he stated that, "Professors that are good teachers made these unit plans, so I see no reason to differ from what has been given to me in the textbook". He takes the plan in the textbook and then makes unit goals based on his current students. He tries to make the most out of what he is given to help his students grasp the mathematics found within that unit. Mr. Yamasaki explained that he doesn't spend a lot of time on the unit plan because he has been teaching for a long enough time that he feels comfortable with the scope and sequence of all the units he will teach that year. When asked about his experience preparing the unit plan in his first years of teaching, he simply stated, "They were long and hard". Younger teachers tend to worry about making sure they teach everything they should, therefore many of their efforts in *kyozaikenkyu* become making the information already given more powerful for the students. Mr. Nagamine is similar in his approach to developing the unit plan. His unit plan never varies from the unit plan in the book. Instead, he told me that he trusts the textbook will be sufficient; therefore, he can focus his *kyozaikenkyu* to improve something else.

Japanese textbooks are different from the textbooks from the United States, and must follow the Ministry of Education's outline for what needs to be taught in each grade. Mr. Matsumoto explained that even if he looked at all seven different textbooks that are available to teach from at the junior high level that the variance between the unit plans would be minimal. Mr. Matsumoto went on to explain the differences between the textbooks when he said, "It is

sometimes interesting to see where the unit plans from the different textbooks differ, and I often find myself wondering why one textbook would teach the mathematics in a specific order where a different textbook would change that order around a little bit".

The *mondai* is another part of *kyozaikenkyu* that content driven teachers take mostly from the textbook. Normally, the *mondai* in the book is given to teachers with specific examples of possible solution methods as well as a good sequence of the lesson. Mr. Yatsushiro explained, "There are teachers that walk from their office to the classroom while reading the textbook and they are able to teach the lesson to the students. I think those lessons are not good lessons, but it happens sometimes". Meaning that teachers can rely wholly on what is in the textbook to know what to teach for that day. Those teachers are not participating in *kyozaikenkyu,* and therefore are not in the content driven or student driven category. The content driven teachers will take the *mondai* found in the textbook and study it. Ms. Minami explained that she uses the teacher's manual to get a feel for what the *mondai* is and where it intends to lead the students. She then thinks about how to use that *mondai* to help her students achieve that same goal.

Instead of spending time to create a new problem, content driven teachers use that time during *kyozaikenkyu* to develop the *hatsumon* of the lesson. This provides a good lesson sequence, as well as pinpoints possible parts of the lesson where students will need extra help. For example, Mr. Nagamine taught a lesson about volume for which he had already done *kyozaikenkyu*. In this lesson, students had to find out the most efficient way of cutting corners on a piece of paper to make a box that will hold the most volume. He explained that the *mondai* in the textbook had students draw a picture of what is happening and then work on the mathematics from there. He thought his students would do better with this *mondai* if they had an actual object to hold and study. He then adapted the *mondai* to have the students try to make the box with the

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most volume by using scissors and tape. This minor adjustment allowed his students to make the

mathematics relatable to themselves and more enjoyable overall. This is the same lesson that

Mr. Nagamine had over twenty *hatsumon* written out as possible questions to ask his students.

He knew that students might struggle in various places and planned to ask questions to help

students continue to progress towards the goal of the lesson. Thus, even though these teachers

are using content that is given to them, they can adjust it to obtain a high-quality lesson (Corey et

al., 2010).

The following figure of the content driven approach illustrates a whole picture of the

process:
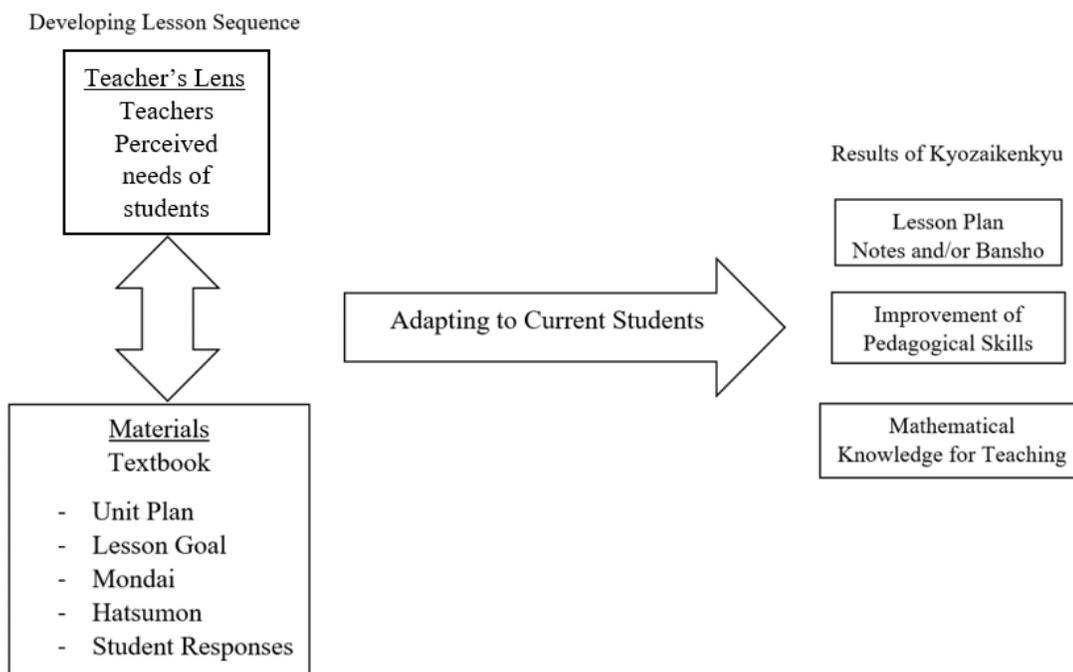
Figure 3. A Content Driven Approach to Daily Kyozaikenkyu

In this figure, the material used is mainly (and perhaps only) the textbook, which contains the

items required to develop the lesson sequence. The materials along with the teacher's

perspective of teaching and learning are then used to adapt the materials to the needs of their

current students. That process is a simple arrow in the figure, but described previously as an activity requiring a large amount of work to transform the lesson into a good quality lesson. Through the process of adapting the materials to their current students, the results are developed as well.

Method 2: A student driven approach. Teachers who normally work closely with professors at universities or have been teaching for many years choose the student driven approach. These teachers have been through many lesson study groups and have developed their own perspectives about what is important to prepare during *kyozaikenkyu*. It would be interesting to delve further into the thought processes behind this change, but that is an idea for future research. However, the teachers that have a student driven approach to *kyozaikenkyu* feel more comfortable with the materials that have been presented in the textbooks, consequently making them more willing to change the *mondai* and outline presented to them.

Two areas of the content driven approach that vary from the student driven approach are the *mondai* and the unit plan. In contrast to the content driven approach, the teachers taking the student driven approach decide what their students need to learn and then find materials to support that goal. This starts with the unit plan. Teachers often use the textbook to have a skeleton of their unit plan. They then decide where one lesson should begin and end to best accomplish the unit goal. The unit goals are the same as in the content driven approach because they do want the students to be able to learn the same material as students in other classrooms and schools. Mr. Shigehara explained his unit planning process stating, "After I have my unit goals, I make a unit plan outline. I decide what I am going to teach each day, and then I know that if I am unable to finish a topic one day, I can adjust my plan to compensate for that". This is different from the teachers that plan for their lesson goals during their everyday *kyozaikenkyu*

instead of the unit plan *kyozaikenkyu*. That is, some teacher's only plan for the lesson topic during their unit plan; whereas, the student driven teachers form lesson goals as well. Mr. Shigehara also likes to look at some of the *mondai* and *kadai* that he will use during his lesson plans as well.

Preparing for the *mondai* is the other portion of *kyozaikenkyu* that is different between these two approaches. The student driven approach teachers like to find problems that students will find interesting and applicable to their lives in the real world. Mr. Yamasaki was a previous example; he brings a camera with him everywhere to take pictures of things that could possibly be a good *mondai* for his students. Mr. Yamasaki falls under this category of student driven approach. He thinks about his students and relates the mathematics to help them find interest in the mathematics. When planning the *mondai*, Mr. Kawasaki often uses his previous year's notes to determine whether the *mondai* is one that he would like to use again, or turn to other materials to develop the *mondai*. If the problem is lacking in desired quality, he turns to magazines, problem books, and personal examples to develop a better *mondai* for his classroom. Often, teachers will develop a *mondai* for a lesson study lesson and then publish those lessons in books or magazines for teachers. This is where Mr. Kawasaki and Mr. Shigehara turn to get these *mondai* that will fit their classroom better than the *mondai* in the textbook.

After developing the unit plan and the *mondai*, the rest of their *kyozaikenkyu* seems to fall into place with those teaching from a content driven approach. I saw lessons while in Japan from both the content driven approach and the student driven approach. Both types of lessons were typical Japanese lessons taught from a structured problem-solving approach. Because I don't have access to the Japanese textbooks, I was unable to determine which was a student driven approach and which lesson was a content driven approach until after I spoke with the teachers

about their *kyozaikenkyu* practices. Therefore, there is not enough evidence to support a claim that one approach is more effective than the other.

The following figure is to illustrate a broad view of the student driven approach:

```
Teacher's Lens
Teacher's perceived needs of students
                    Developing Lesson Sequence              Results of Kyozaikenkyu
         General Structure of Unit    Specific Lesson Decisions
Adapting to Students                          Lesson Goals        Lesson Plan Notes and/or Bansho
              Unit Plan                                            Improvement of Pedagogical Skills
                                              Hatsumon
              Mondai                                              Mathematical Knowledge for Teaching
                                           Student Responses
Materials
Lessons Notes
Internet
Magazines
Books
Textbooks
Real World
Colleagues
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Figure 4. A Student Driven Approach to Daily Kyozaikenkyu

This figure is more complicated than Figure 3- A Content Driven Approach to Daily Kyozaikenkyu. It is similar to Figure 3 in the fact that they both use the materials and the teacher's lens to adapt the materials to their students. The difference, however, is that the materials that the teachers use from the student driven approach are more varied. The materials could also contain all the required aspects of the lesson sequence; however, the teachers use the materials and their lens to develop that lesson sequence. The first thing teachers develop in this approach is the unit plan and the *mondai* for the lessons. These are the general structure for the unit. They help teachers see the whole unit and make sure that lessons are connected and build upon each other. After developing the general structure of the unit, teachers then move on to the

more specific details, namely the lesson goals, the *hatsumon*, and the potential student responses. They are developed from the materials listed in the figure as well; however, they are directly correlated with the *mondai* for that lesson. Through developing the lesson sequence, teachers in the student driven approach also develop the items in the results section.

Differences between Daily Kyozaikenkyu and Kyozaikenkyu Done for a Research Lesson

Most of the research literature referenced *kyozaikenkyu* from a lesson study perspective, whereas I am studying *kyozaikenkyu* from a daily perspective. I asked teachers and educators I interviewed what is the main difference between their everyday *kyozaikenkyu* and lesson study *kyozaikenkyu*. The answers varied more than expected. Most of the teachers talked about the depth of lesson study *kyozaikenkyu* compared to daily *kyozaikenkyu*. Some teachers talked about the audience for whom the study must be presented. The audience is visible in the representations of the study; namely, lesson plans for lesson study and teacher notes for daily *kyozaikenkyu*. The last thing teachers mentioned as a difference was that lesson study has a theme or focal point while doing *kyozaikenkyu*.

Depth of lesson study kyozaikenkyu compared to daily kyozaikenkyu. Ms. Minami explained that, "The time spent on my lesson study *kyozaikenkyu* takes a lot longer. I already have the theme for this October lesson study and I have been reading through magazines and books to start to prepare for it". This interview was done at the end of August. Compared to some teachers who did daily *kyozaikenkyu* a week before teaching the lesson, Ms. Minami had met with her professional development group for her lesson study and was already having *kyozaikenkyu* two months in advance. Mr. Yamasaki explained more in depth about the difference in total time spent on *kyozaikenkyu* by saying, "It is hard to find time every day to do the perfect *kyozaikenkyu*. Look at what you do for *kyozaikenkyu* for a research lesson for lesson

study, and then take a portion of that *kyozaikenkyu*. That portion becomes about what you are able to accomplish for your everyday *kyozaikenkyu*". Meaning that everyday lesson is only part of the whole picture of *kyozaikenkyu*. This response however brings up other questions about what portion of lesson study is needed for everyday *kyozaikenkyu*. From my daily journal, I wrote that teachers often study things they feel they need to improve for that lesson. For example, in one lesson a teacher might feel that the *mondai* is weak and thus works on developing that *mondai* for *kyozaikenkyu*. Whereas, in another lesson that same teacher might feel they need to research further into the possible student responses and spend more time on that. Therefore, setting a specific start and end to daily *kyozaikenkyu* is not possible.

During lesson study *kyozaikenkyu*, the teachers start from discussing where the specific lesson begins in the unit plan. Therefore, they must know about the unit plan and the students' previous knowledge as well as how the lesson will tie into other parts of the unit. This horizontal study is part of the unit plan *kyozaikenkyu* done during lesson study; however, they also prepare vertically to some degree. After the unit plan has been sufficiently researched, teachers will delve into looking for a mondai to fit the lesson they are preparing. Dr. Ninomiya explained, "Teachers rarely use the problem in the textbooks for lesson study, because they are not up to the level that they want to present to the other teachers and professors" (Ninomiya, personal communication, 2017). The method of selecting the *mondai* during lesson study *kyozaikenkyu* resembles the student driven approach. When I asked teachers about differences between lesson study *kyozaikenkyu* and everyday *kyozaikenkyu*, the teachers more in line with content driven approach had a very firm belief that the *kyozaikenkyu* was done very differently. Conversely, the teachers with a student driven approach initially explained that *kyozaikenkyu* is the same for both

types of lessons, but that *kyozaikenkyu* done for lesson study requires a little extra effort and work because of the audience.

After the *mondai* has been selected, the possible student responses and the *hatsumon* are prepared. Mr. Shigehara states, "During everyday *kyozaikenkyu,* I normally look at the student responses and change course during the lesson depending on those responses. Whereas in lesson study I have about five different plans that the class could take and I try to prepare all of them and consider which one is the best route to take". The first part of this quotation shows Mr. Shigehara's *kyozaikenkyu* was about the *hatsumon* and the possible student responses. Mr. Shigehara is more in line with a student driven approach to *kyozaikenkyu*. Therefore, talking about those student responses shows his preference to what he thinks about during *kyozaikenkyu*. This is how lesson study *kyozaikenkyu* differs from the student driven approach for Mr. Shigehara.

The next part of his quotation relates to the next section of differences between lesson study *kyozaikenkyu* and daily *kyozaikenkyu*. He explains that he develops plans for five different ways of teaching the lesson and then decides which one is the best. During lesson study meetings, normally following the lesson, teachers and professors often ask if they have considered alternate methods of teaching, and then ask why they chose a specific method of teaching. Sometimes those teachers and professors have a specific way of teaching a concept and will want to know why a different method was picked. This shows that lesson study *kyozaikenkyu* is done with a different audience in mind than that of the daily *kyozaikenkyu*, which is a large part of why teachers spend more time on their lesson study *kyozaikenkyu*. To explain their thinking, they also make a detailed lesson plan which takes a good deal of time.

Teachers explained they feel *kyozaikenkyu* for lesson study takes more time and is more in depth. This is because they have many more activities they attempt to accomplish during lesson study *kyozaikenkyu*. Where the unit plan *kyozaikenkyu* and daily *kyozaikenkyu* can be done separately, most of the teachers combine them into one broader *kyozaikenkyu* when talking about lesson study.

Lesson plan compared to teacher notes/bansho plan. In Japanese culture, having honor and respect for superiors both socially and professionally is very important. One of the best examples of this principle is a metaphor with a paper crane. If you give someone a paper crane, it symbolizes good fortune and good health. However, if you give someone a paper crane that is poorly constructed, even if your intention is good, the person will assume that you do not care about their fortune or health because you lacked the effort and time required to make a proper paper crane. This side of the Japanese culture is prevalent in the next section where I discuss lesson plans that teachers make because of *kyozaikenkyu*. Lesson study is done in a group comprised of professors and teachers that have varying levels of experience. Before the teacher delivers the lesson for which they have prepared, they often have a lesson plan meeting with the professor specifically over them. They also have a pre-teaching meeting with the whole group to explain the lesson plan they have developed. Because all the teachers will get a copy of the developed lesson plan, the teachers feel it must be perfect because they would not want to give anyone an imperfect paper crane to show any sign of disrespect.

The process of lesson study is more complex than I have cited, but I have mentioned some activities to show that others see the lesson plan. During a normal lesson taught in their classrooms, teachers make notes to keep organized, but no one else must see these notes except for themselves. Mr. Yatsushiro explained, "For everyday lessons I make notes, but it doesn't

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reach the lesson plan potential. For a research lesson during lesson study you make a lesson plan. The lesson plan is for other people. You want them to understand your reasoning behind your choices, where the everyday lesson notes are for yourself. You don't need to explain your decisions to yourself". This feeling of making something better for others than for yourself is a markedly Japanese way of thinking about professional work. Mr. Yamasaki reaffirmed this feeling when he told me, "The hard part is that others need to know your ideas. For everyday *kyozaikenkyu* notes are enough". Both Mr. Yamasaki and Mr. Yatsushiro refer to lesson plans and notes as products of *kyozaikenkyu*. Some of the teachers consider making the lesson plan or teacher notes part of *kyozaikenkyu*, while other teachers say that you make the lesson plan and notes after you are done doing *kyozaikenkyu*. Regardless if making notes or lesson plans is part of *kyozaikenkyu*, they are directly tied to the teacher's *kyozaikenkyu*. To understand the differences, I was shown lesson plans and notes the teachers make for everyday lessons.

The lesson plans created during *kyozaikenkyu* for a research lesson were extremely detailed in noting their decisions and possible student responses. They also show a picture of the chalkboard and how they will lay out their chalkboard to help students easily take notes. The lesson plan goes on for four to five pages explaining the teachers thinking and the method of preparing for the lesson. They are specifically made to allow other teachers to read the lesson plan and 1) understand the mathematics behind the different possible student representations and 2) use the teachers lesson plan to teach a similar lesson of the same quality of instruction. All the information that teacher needs is included in these lesson plans. I observed many different lessons in Japan and every time, I was given a detailed lesson plan to follow along with the teachers reasoning behind the moves they made.

In comparison to the lesson plan, teacher notes are outlines of what the teacher has prepared for. Dr. Souma explains that he always makes sure to write down four things to make his notes. They include: the lesson goal; the *mondai*; the *hatsumon*; and the *matome* (Souma, personal communication, 2016). This idea from Dr. Souma is more than some teachers wrote down for their notes. Mr. Kawasaki explained, "There are two types of teacher's notes. The first set of teachers only write down the *kadai*, or lesson goal. The second set of teachers writes down the lesson goal, the *mondai* and the *hatsumon* that they are going to use". This confirms that some teachers go into their classroom having only written down the goal, yet they have a plan in mind because of the *kyozaikenkyu* they held.

Another version of teacher notes is called the *bansho* plan. This is a plan for how the chalkboard will look at the end of the lesson. At the junior high level, teachers try not to write anything on the board it is important enough for the students to write down as well. They have a plan of how they want the chalkboard to look at the end of the lesson; the plan includes student ideas, the *mondai*, and important *hatsumon* that the teacher wants the students to think about. This *bansho* is a type of teacher notes because if the teacher has a plan for their board work, then they have written down the *mondai*, the lesson goals, and the *hatsumon*. They also have a general idea about the lesson sequence. See Figure 5 below for an example of a teacher's *bansho* plan. This was completed before the teacher taught this lesson; she then took a picture of it and used that as her notes to teach the lesson.
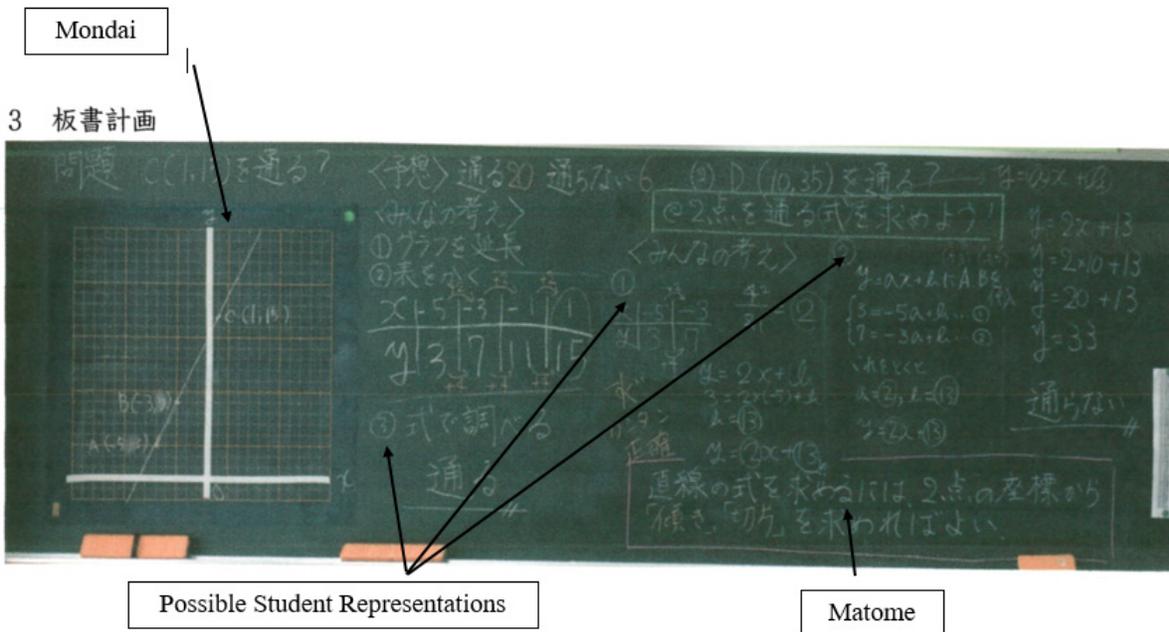
Figure 5. Sample Bansho Plan

Mr. Yatsushiro explains that, "the result of lesson study *kyozaikenkyu* is different than the daily lesson study (referring to the lesson plan), however, the activities are the same". That is, even though teachers separate out the days when they do *kyozaikenkyu* for the various aspects of their lesson, the activities are the same, but not necessarily with the same amount of depth as they would during lesson study.

Lesson study has a theme. One of the main differences between lesson study and an everyday lesson is that the lesson study is done with a research theme. This theme is not just professional development or the development of a good lesson, but they have a specific goal that the group studies. Some of the books that I brought home from Japan contain lesson plans from teachers that taught in a school for that specific theme. Themes range from "teaching functions" to "how to use technology in the classroom more efficiently". Mr. Nagamine states, "Sometimes the theme is not math related, but more general for all teachers. Tying the theme into

mathematics can be difficult. Depending on the theme of the lesson study, the *mondai* can change to fit the needs of the theme". I was unaware how much a theme affected the *kyozaikenkyu*, yet these teachers need to prepare their lesson around the theme of the lesson study. Ms. Minami explains that sometimes the lesson study talks about improving teaching methods, so she goes to bookstores and buys books on that topic to consider how she could improve her craft of teaching. This idea of improving your own craft is also part of everyday *kyozaikenkyu*; yet, in everyday *kyozaikenkyu* teachers choose the area they want to improve.

Through these themes, teachers are able to use those new-found tools or teaching practices in their everyday lessons. This will affect their daily *kyozaikenkyu* because the teacher's thinking and decisions may change based on what they learn. I asked teachers where they learned how to do *kyozaikenkyu* and lesson study was a common answer among them. They work with other teachers and professors and ask specific questions about areas in their *kyozaikenkyu* they need to improve, as well as gain ideas about how to research and study a topic during *kyozaikenkyu*.

Results Conclusion

The separation between *kyozaikenkyu* and lesson planning was a difficult one to make, therefore, I tried to flesh out the differences between them. One explanation given on the difference was that the collection of the physical materials, like copies or handouts for the students, was not doing *kyozaikenkyu*, yet still doing lesson preparation. Two out of the ten teachers interviewed draw the line where *kyozaikenkyu* ends to be when the lesson plan is being formed. They claim that *kyozaikenkyu* is everything you need to do to get ready for writing your plan for that day. Teachers usually do this through their notes or writing a *bansho*. However, two teachers claimed that writing the *bansho* plan is also part of *kyozaikenkyu* because you can

still change your ideas when you finally write down the flow of the lesson. Overall, I feel the line where *kyozaikenkyu* ends and lesson preparation continues on is a large grey area depending on your personal description of *kyozaikenkyu*. Therefore, an exact description of where *kyozaikenkyu* ends and lesson preparation continues is difficult to develop. However, there is a quote from Mr. Miyazaki demonstrating that while there is no "letter of the law", there is a "spirit of the law" about what is called *kyozaikenkyu*. He states, "Even though I have taught the lesson before, I want to make it better. That's why I do *kyozaikenkyu*". That is, even though a teacher has the lesson plan they have taught before, even if it is a good lesson, there is a desire to become better than before. The "always improving" mentality (Corey et al., 2010) is the essence behind why teachers do *kyozaikenkyu*. Towards the beginning of a teacher's career, *kyozaikenkyu* does feel more like lesson planning because they are developing a lesson for the first time. *Kyozaikenkyu* then becomes something completely different in the later years of a teacher's career because they are improving upon these lessons.

CHAPTER 6: DISSCUSSION

What is Daily *Kyozaikenkyu*?

This section of this chapter describes everyday kyozaikenkyu as it is related to areas in which were mentioned in the literature review and theoretical framework.

High-quality instruction. To address my research question "What is daily *kyozaikenkyu?"*, I must first realize the magnitude of that question. This question has been narrowed down from the initial question "What is *kyozaikenkyu*?" to focus on daily *kyozaikenkyu*. However, there seems to be a wide variety of descriptions and thought processes when making conclusions about daily *kyozaikenkyu*. Therefore, instead of trying to describe activities and specific lengths of time, we should approach this question with the goals and products of daily *kyozaikenkyu* in mind. One key product that teachers gain through performing daily *kyozaikenkyu* is that their instruction increases in quality.

As previously mentioned, one of the chief reasons I considered Japanese teachers to improve my own teaching was because of their high-quality instruction. Stigler and Hiebert (1999) attribute this level of instruction to lesson study, while Corey et al. (2010) attribute their success through training and an "always improving" mentality. K*yozaikenkyu* is a direct result of these teacher's "always improving" mentality. As mentioned in the results, *kyozaikenkyu* allows teachers to make their lessons better even though they may already have a good lesson. When Takahashi and Yoshida (2004) explain that "*kyozaikenkyu* is an essential component to a successful lesson study", I feel that the teacher's continuous improvement is an essential reason for this claim. When teachers do *kyozaikenkyu,* they improve their lessons and are therefore able to have a successful lesson study. If a teacher shows up unprepared to the pre-lesson discussion of why they made their decisions, then other teachers will not be edified by those meetings. This

relates to daily *kyozaikenkyu* because teachers use their lesson study *kyozaikenkyu* as an overarching idea. Then they pull little aspects of that process into their everyday *kyozaikenkyu*. Some days they will try to improve their own teaching skills, while other days they will delve into other sources to find a better *mondai* to ask students. Teachers get ideas from other teachers and professors during lesson study that they can implement during their everyday *kyozaikenkyu*.

Varying descriptions. When first researching *kyozaikenkyu*, there were descriptions given by teachers that tended to be polarizing ideas. The first description given by Takahashi (2006) expounded upon instructional materials by giving various types of materials, however the "research" aspect was left out. The second description was given by Shimizu (1999) and talked about what teachers try to accomplish during *kyozaikenkyu*. The focus of Takahashi's description (2006) is focused on the instructional materials which is in line with 5 out of the 10 instructors interviewed that I decided to call the content driven approach. Shimizu's description (1999) describes creating a lesson around their student's responses and catering the lesson to their needs. This description lines up with the Student driven approach found in the results section. Therefore, the descriptions are both describing *kyozaikenkyu*; however, they are describing the different approaches that appear in the results. One thing that remains unclear is that the descriptions are describing *kyozaikenkyu* from the perspective of lesson study, where the two different approaches are defining daily *kyozaikenkyu*. The teachers described that lesson study *kyozaikenkyu* was more in line with the student driven approach than the content driven approach. What I have come to conclude is that Shimizu's (1999) description of *kyozaikenkyu* is describing the goals that teachers want to accomplish during *kyozaikenkyu*, while Takahashi's (2006) description describes the tools that one can use to achieve those goals. Instead of the descriptions being polarizing, they are describing different aspects of *kyozaikenkyu*.

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In Takahashi's (2006) description of *kyozaikenkyu*, he says, "choosing the best resources is also an important part of planning lessons. These resources include not only good problems in textbooks and other resource materials but also manipulatives, video, and interactive tools on the internet. Teachers should know the potential benefits and drawbacks of each resource" (Takahashi, 2006, p. 3-4). At first glance, this description seems to be more in line with the student driven approach because he talks about using more materials than just the textbook. However, the focus is on the materials and how to use the materials in a beneficial way. This is more in line with the content driven approach. Takahashi (2006) also describes *kyozaikenkyu* as "an important groundwork for planning the lesson" (p. 4). That is, there are other aspects of planning a lesson that are not considered *kyozaikenkyu*. This is interesting because 9 out of 10 teachers were unable to provide me with any aspect of planning a lesson that would not be included in the shroud of *kyozaikenkyu*. This description is also developed when looking at *kyozaikenkyu* in a lesson study setting. All the teachers described doing *kyozaikenkyu* for lesson study as a student driven approach, where this example differs from the norm.

Other descriptions examining *kyozaikenkyu* in a lesson study setting are comparable to the content driven approach. For example, Fujii (2015) describes *kyozaikenkyu* as "examining teaching materials and tasks from mathematical and educational points of view as well as from the students' prior point of view. Moreover, Japanese teachers also investigate ways to encourage students to solve a task by themselves" (p. 278). The description about the students' prior point of view and ways to encourage students to complete the task by themselves is evident because the teacher should be focused on the students while going through *kyozaikenkyu*. However, he does talk about using teaching materials already developed, which sides more with a content driven approach.

The following is another description that leans more towards a content driven approach: "This material research goes well beyond looking at the local textbooks, the teachers, for instance compare how different materials treat the same subject. They find out what the current research says about the teaching and learning of the topic. This often includes gathering knowledge about pupils' prior learning within the subject area to be taught so that they can anticipate pupils' reactions and solutions" (Juhler & Haland, 2016, p.3). Even though they describe teachers doing more than looking at the textbook, the teachers are making the information in the textbook meaningful to students by looking at previous knowledge and possible student responses. This is very like the content driven approach; however, they describe teachers comparing how different materials treat the same subject. This activity is like what teachers do during the unit planning *kyozaikenkyu* rather than the daily *kyozaikenkyu*.

As previously mentioned, *kyozaikenkyu* is so natural to Japanese educators that they have a difficult time defining it. I am reminded of the parable of the blind men and the elephant. Each blind man is describing a different part of the same creature, yet their descriptions are so different based on what they are experiencing. This is how I view what educators are describing with their descriptions in the literature as well as the descriptions that the Japanese educators have provided for me. They are all depicting the same creature, yet their descriptions are varied based on their experiences.

Through my experiences in *kyozaikenkyu*, I now understand why it is so difficult to define. After all the interviews and conversations, I have had about *kyozaikenkyu*, Shimizu's (1999) description of *kyozaikenkyu* is the closest to depicting daily *kyozaikenkyu*. However, it does not incorporate all the description. Starting with Shimizu's (1999) description I will add in parts that I feel are missing in italics. He states, "*Kyozaikenkyu* refers to the careful analysis of

the topic *and selection of the mondai* in accordance with the objective(s) of the lesson. It includes *improving the teachers' understanding of mathematics though* analyses of the mathematical connections both among the current and previous topics (and forthcoming ones, in some cases) and within the topic. Also included are the anticipation of students' approaches to the problem and the planning of instructional activities based on the anticipated responses. *Lastly it would include improving the teacher's craft of teaching through various forms, such as reading materials that include methods of improving teaching or seeking guidance of colleagues or mentors.*"

One distinction that I do need to make is that while teaching, I often felt that what I was teaching my students had immense value, however, my students did not feel the same way. If students do not view the lesson as valuable then the lesson has no value. It is important to think about student thinking while in this process, which can be a difficult task to accomplish. It is, however, crucial to the process.

How does this research relate to teachers in the United States?

Thinking back on my experiences as a teacher, I asked myself if teachers did *kyozaikenkyu* in the United States. Teachers from the United States plan for their lessons to some degree, but how similar are the activities in planning for a lesson in the United States to *kyozaikenkyu* in Japan? As Fujii (2013) claims, *kyozaikenkyu* is a part of lesson study that is not transferring to those of other cultures. However, I do feel that teachers from the United States have had lessons in which they have done *kyozaikenkyu*. I do not however, feel that teachers from the United States are participating in daily *kyozaikenkyu*. I remember lessons in which I made sure that I taught from a problem-solving approach to allow my students time to work on a mathematical task. I thought about potential outcomes of the lesson, representations I wanted to

show the entire class, and problem areas where students might get stuck. The preparation that went into those lessons far outweighed the preparation that went into my standard lesson taught in the United States as described by Stigler and Hiebert in the Teaching Gap (1999). This is important to note because if teachers view the standard lesson from the Teaching Gap as a high-quality lesson, their *kyozaikenkyu* will be different from a teacher who views a lesson from a structured problem-solving perspective. Therefore, a teacher's view on what determines a high-quality lesson is a driving force into what is deemed important during *kyozaikenkyu*.

Teachers in the United States have an innate desire to teach students something meaningful. Whether that is mathematics or critical thinking, the goals of the lessons vary. I asked my colleague in Japan what drives Japanese teachers to do *kyozaikenkyu* every day, to which he responded, "I think the major reason for *kyozaikenkyu* is the teachers' passion for a good lesson. As a professional teacher, most of the teachers want to do a better job, and they believe the teachers' 'better job' will make all the students happy" (Ninomiya, Personal Communication, June 2017). This statement could be said about teachers in any culture. Teachers want to do a better job. Japanese teachers however, feel that if they have a lesson that they deem as a failure, then the *kyozaikenkyu* was insufficient. Because the foundational driving force behind *kyozaikenkyu* exists in the culture in the United States, teachers in the United States can be successful in doing *kyozaikenkyu* when taught properly.

Since the motivation behind this study was to improve teaching in the schools in the United States, how does this knowledge of *kyozaikenkyu* affect teachers here in the United States and across the world to increase the quality of these lessons? From my personal experience, there are three areas that would be directly affected if teachers implement this type of daily *kyozaikenkyu*: 1) Teacher's would be able to participate in professional development that is

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specifically tailored to their needs 2) Teachers would be better prepared to teach from an inquiry based approach to teaching 3) Teachers would be able to use the textbook more efficiently.

Professional development. During my six years of teaching in a high school, I participated in many different professional development activities. Depending on the principal and the push from the district, the topics ranged from having more rigor in the classroom to involving parents in educational process. I often thought during the professional development sessions that the topics chosen were a mile wide and an inch deep. Meaning, that the topic was trying to cover all the content areas, instead of being specific towards mathematics. They were hard to relate towards mathematics and I rarely felt I was gaining any skills professionally. I was excited to learn that my district was also going to hold professional development classes specific towards mathematics teachers. As I went to these classes, they were geared towards showing the benefits of teaching from an inquiry based approach instead of the traditional approach to teaching in the United States (Stigler & Hiebert, 1999). I knew that I already wanted to teach from an inquiry based approach, which is very close to the structured problem-solving approach; however, I found myself lacking specific skills to be successful in that approach. The professional development classes I endured did not focus on my specific needs, and therefore, I was in the same predicament of being unable to teach form the inquiry approach even after the courses. After researching and learning about daily *kyozaikenkyu*, I have found this would be an excellent opportunity to tailor the professional development to fit teacher's needs.

Through developing skills and mathematical knowledge for teaching, teachers can better accomplish the requirements of their station. However, to obtain the level of improvement that the Japanese educators achieve, teachers must be greatly self-driven to improve one's own craft of teaching. The professional development classes done through my school are compulsory, just

like each school in Japan usually does one lesson study per year. Also like Japan, when the

school is holding the professional development, they can choose the topic, which may or may not

relate to the skills and pedagogical studies that are needed to improve individual skill. Through

daily *kyozaikenkyu*, a teacher can improve on their own skills, but they can also use that time

participating in the other activities of *kyozaikenkyu*. Therefore, teachers will have to first realize

they need to improve in a certain area, whether through help of a different teacher or self-

realization. Then, they must make time to improve that craft. In the results section, we saw

teachers doing this on their own during daily *kyozaikenkyu*.

Teachers are better prepared to teach from an inquiry-based approach. The results

show Japanese teachers are preparing for teaching from the structured problem-solving approach

(Stigler & Hiebert, 1999). *Kyozaikenkyu* could be adapted to teach from all different approaches.

However, all the teachers that were interviewed teach from a structured problem-solving

approach. The structured problem-solving approach is similar to inquiry based approaches here

in the United States that teachers use to allow students to critically think.

When teaching high school here in the United States, I tried to teach from an inquiry

based approach. I found that I was lacking in several areas making my lesson unsuccessful,

meaning that I was unable to accomplish my goals for that lesson. Some of the things tripping

me up were student's answers surprising me, students not engaging in the activity, running out of

time (resulting in no *matome)*, and inability to tie together the problems from the lesson and

problems in standardized tests. *Kyozaikenkyu* is a tool to help teachers alleviate these problems.

Proper preparation is key to having a successful high-quality lesson. Students should be

interested in the problem, so potential student responses and how they connect with the main

idea should also be prepared for when planning the *mondai*. The connections to the main goal of

the lesson really tie together the mathematical knowledge for teaching that teachers should have to guide students of all abilities to the correct idea.

Teachers will be able to use textbooks more efficiently. As a teacher, most of my unit pacing guides came from the textbook. We were told by the state office the items we needed to cover during the year, and then we decided where to start and end a lesson based on the textbooks. Often, topics that students already understood received the same amount of teaching time as topics that students struggled with. Some topics could have used more time to explore and understand. The textbook also gave sample problems and homework problems that students used to learn and do homework from. Therefore, students learning these topics would have no difficulty solving questions that came from the specific textbooks, however, when they were faced with a similar problem asking the question in a different fashion, then students were stumped. The dependence on the textbooks by both teachers and students was frustrating for a teacher trying to help students think critically about mathematics. As a department, we tried to select good textbooks. We selected from four different companies, but we found problems with each one. This left us as teachers to develop our own lessons, sample problems, homework problems, and essentially our own textbook. I feel that if we as teachers held daily *kyozaikenkyu,* the dependence on pacing from the textbook would dissipate and allow room for teachers to develop a plan based on the needs of their students.

Japanese teachers were also dependent on their textbooks, but the difference in the textbooks in the United States and Japan are alarming. This is a topic for further discussion at another time. One difference between Japanese educators and myself is even though they have a pacing guide set by the textbook, they will still research and think about their students to ensure it is the best pace to teach their students. Through *kyozaikenkyu*, the connections between the

topics are more prevalent in the teacher's mind and allow the teachers to know the areas in which the students will struggle. This aids teachers in developing their lessons to achieve a high quality of lesson tailored for their students.

I asked Dr. Souma about textbooks' role in *kyozaikenkyu*. He replied that even though textbooks in Japan are better prepared for teachers to participate in this type of *kyozaikenkyu*, the textbooks in the United States are full of teaching materials that have great potential, it all depends on how they are used. He says, "In Japan there is a discussion about 'teaching the textbook' versus 'teaching mathematics by using textbook'. Most teachers try to "teach mathematics by using the textbook'. In this sense, teachers need to do *kyozaikenkyu* to help them decide what they are going to use from the textbook in their lessons" (Souma, Personal Communication, 2017).

Effect on lesson study in the United States

Without completing a proper *kyozaikenkyu*, lesson study will be unsuccessful (Takahashi & Yoshida, 2004). Through knowing what daily *kyozaikenkyu* is and practicing it daily, teachers can better hold *kyozaikenkyu* for lesson study. This process becomes less daunting, and teachers can develop the understanding behind why they are doing certain activities during the process. Lesson study will become more beneficial for teachers and professors if the lessons have been researched. Although teachers can learn how to do daily *kyozaikenkyu* from lesson study, if they continue those practices daily, then their *kyozaikenkyu* for lesson study will become more meaningful for the lessons that they develop.

Areas to still be researched

This thesis was my first time being a researcher and interviewer. I quickly found out during the analysis that there are many questions I wished I would have asked the participants.

For example, I often asked teachers about the very first activity that they try to do during *kyozaikenkyu*. From their answers, I learned about all the different materials that teachers use during *kyozaikenkyu*, but I realized that I wanted to know the purpose behind looking in the textbook versus looking in a magazine. The purpose behind their actions was difficult to bring out in the interviews.

There are also other words defined in the literature that I thought I understood, but they are just as complicated as *kyozaikenkyu*. The words *mondai*, *kadai*, and *hatsumon* are commonly used words, however, teachers from different areas in the country use them differently.

I also failed to ask the teachers that looked at *kyozaikenkyu* from the student driven approach when and if they made the change from the content driven approach. There was more information I could have gained by asking the right questions to allow the participants to explain their thinking; however, I often accepted a one-word answer and moved on to my next question.

Even though I could have done a more thorough job at gathering data, this research project has helped me gain insight into the world of teaching mathematics in Japan. There are many questions that have developed that need to be researched as well. The following questions could be researched to help teachers better understand daily *kyozaikenkyu*:

- Why do teachers tend to move from a content driven approach to the student driven approach?

- What are the different aspects of a *hatsumon,* and why are there seemingly conflicting ideas about the description?

- What are the differences in Japanese educator's lesson plans? What is the difference between the lesson plan they write for lessons study and what they develop for everyday teaching?

- How do Japanese textbooks compare in relation to textbooks from the United States?

- Does implementing daily *kyozaikenkyu* help lesson study groups? I would like to approach a current lesson study group and introduce daily *kyozaikenkyu* to see if it improves what they are trying to accomplish.

- What are the connections between the *kadai* and the *mondai*? How are they used in the teaching sector of Japan?

- Do teachers learn about the curriculum maps in college or is that knowledge developed over time in teaching?

- What are the defining characteristics of *fuzoku* schools? How do *fuzoku* schools differ from the regular schools?

Conclusion

Trying to pinpoint a single description of daily *kyozaikenkyu* has been a difficult process. It is a cultural phenomenon that teachers inherently understand in Japan, yet Japanese teachers have developed their own styles and ideas about what daily *kyozaikenkyu* is. This is the same process that teachers interested in daily *kyozaikenkyu* need to go through. Developing a style and idea about what *kyozaikenkyu* is will be essential to achieving high quality instruction. My ideas on what to do during *kyozaikenkyu* or what the most important aspects of daily *kyozaikenkyu* are may differ from my Japanese colleagues, but the purposes of daily *kyozaikenkyu* are common. Hiro Ninomiya told me that Japanese teachers are not professional teachers right out of college. They experience success and try to mimic those lessons, but more importantly, they experience many failures and learn from those as well. After reading this thesis, I do not expect teachers to

hold a perfect *kyozaikenkyu* every day; but, I hope it will provide the foundation for teachers to

explore *kyozaikenkyu* and adapt the activities to fit their needs and goals.

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APPENDIX A: A GLOSSARY OF JAPANESE TERMS

Hatsumon - a key question for provoking student thinking during the lesson.

Kikan-Shido - instruction at students' desks

Neriage - to help "polish up" the student's methods and ideas through a whole class discussion

Bansho - the ability to use the chalkboard to help promote students' thought processes

Matome - to "sum up" the lesson, and review the lesson objective(s)

Mondai - a problem for the lesson, often called a lesson task in the United States

Kadai - something that the students should gain through solving problems (lesson goals)

APPENDIX B: A SAMPLE UNIT PLAN

3. Unit objective
(1) Interest/motivation/attitude toward mathematics
The students will recognize the benefit in using quantity per unit for efficient comparison of ratios of different amounts.
(2) Mathematical thinking
Students perceive the benefit of comparing values by quantity per unit and are able to utilize the concept.
(3) Ability
Students are able to compare values of different mixture by considering their quantity per unit.
(4) Knowledge/Comprehension
-Students understand what it means to compare 2 different variables by quantity per unit.
4 Instruction plan Today (lesson ⅛)

Hour	Objective	Learning Activity	Standard Measure for Evaluation
1 Today	Be able to understand how to compare area and population of various mixture, and be able to perform comparison.	Think of ways to compare rooms with various area and population.	Students try to uniform the value to either area or population for comparison.
2	Know that quantity per unit means "population per 1m^2" and "area per person", and know their meaning and understand their benefit.	Think of the difference between an equation which solves for quantity per 1m^2 and quantity per person. Review comparison lessons since grade 1; students recognize that the problems are easier to understand if the bigger quotient is more congested.	While comparing the degree of mixture, students perceive the benefit of quantity per unit and are able to explain it. Students understand what per-uni quantity comparison means.
3	Understand "population density" and understand how to solve for it.	• Students compare the population density between North Tokyo district and Vancouver. • Students become aware of "population density" and are able to solve for the same.	Students are able to solve for population density. Students comprehend what population density is.
4	Be able to solve problems using quantity per unit.	Students are able to compare rice mixture through application of quantity per unit.	Students are able to compare 2 variables through quantity per unit.

5	Deepen understanding of quantity per unit by applying pre-learned division and multiplication	Think of how many meters of 7g/m wire will be used to complete a craft project that requires 52.5g of the wire.	Students are able to solve for the total quantity by applying quantity per unit thinking. Also, they comprehend that the past division/multiplication situations include quantity per unit.
6	Increase interest by deepening lesson material through arithmetic activity.	Be able to recognize situations that utilizes quantity per unit in everyday life.	The students engage in activities by trying to apply the current material.
7	Solve problems by applying the lesson material.	Begin on the "Skill Improvement" problems.	Be able to apply the skills learned in this lesson in solving for the answer.
8	Confirm the students'———— and solidify their comprehension.	Begin on the "Review" problems.	The students have acquired the basics of the learned material.

APPENDIX C: INTERVIEW PROTOCOL

For your information, this interview is part of a study being done to help researchers from the United States gain insight on the practice of *kyozaikenkyu* here in Japan.

1. What is your name?
2. What grade level do you teach this year?
3. How long have you been teaching?
4. How did you come to learn how to do *kyozaikenkyu*?
5. What do you find the most challenging thing about holding *kyozaikenkyu*?

The next few questions are going to be about a *kyozaikenkyu* that you held last week for a particular lesson.

6. Think about the lesson last week that you taught where you did the most planning to prepare for it.
   a. What topic was it?
   b. What was the first thing you did that you would consider to be *kyozaikenkyu*?
      i. What was your main goal for (said activity)?
      ii. What materials did you use while doing (said activity)?
      iii. What did you learn about (said topic) while doing (said activity)?
      iv. In what ways did you find (said activity) productive?
   c. Repeat part b for other activities done that were considered *kyozaikenkyu*.
   d. If this was a "research lesson" for a lesson study group, how might the *kyozaikenkyu* be different? What would you have done differently during the *kyozaikenkyu* phase? What would you have done the same during the *kyozaikenkyu* phase?
   e. Is there any other activity that you did during lesson planning that you would NOT consider to be *kyozaikenkyu*? What are they?

The next few questions are going to be about a *kyozaikenkyu* that you are going to hold in order to prepare for an upcoming lesson.

7. Think about a topic that you need to teach in the upcoming weeks in which you anticipate that you will have to spend a lot of time planning for.
   a. What topic is it?
   b. What is the first thing you will do while holding *kyozaikenkyu* for this topic?
      i. What will be your main goal for (said activity)?
      ii. What materials will you use while doing (said activity)?
      iii. What do you expect to learn from doing (said activity)?
   c. Repeat part b for other planned activities while holding *kyozaikenkyu*.
   d. Why do you think *kyozaikenkyu* is important to do for this topic?
   e. If this was a "research lesson" how would you approach *kyozaikenkyu* differently? What would you do that is the same?

The next questions are a bank of questions that if time permits they could be asked depending on the subject's previous responses. Some of these questions could be used during the other parts of the interview based on responses given.

8. Are there any other materials that you use regularly while doing *kyozaikenkyu* that you have not mentioned yet?
9. If you were going to explain the process of *kyozaikenkyu* to a student that is just starting a teacher education program what would you say? If you were going to explain *kyozaikenkyu* to a first-year teacher would you tell them something different?
10. How can you tell if your *kyozaikenkyu* is good or not? How can you tell if another teacher's *kyozaikenkyu* is good or not?
11. How do you know if you are done with *kyozaikenkyu*?
12. Some Japanese teachers say that *kyozaikenkyu* is 50 of the lesson planning, others say 90%, what would you say it is? Why?
    a. What planning activities are NOT *kyozaikenkyu*?
    b. Why would there be such disagreement among teachers about this?
13. What would happen if a teacher did not do *kyozaikenkyu* for a lesson?
14. Is there anything else about *kyozaikenkyu* that you want to add?