

Supporting the Effective Implementation of a New Mathematics Curriculum: A Case Study of School-Based Lesson Study at a Japanese Public Elementary School

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Abstract The Japanese national standards, known as the Course of Study (COS), is revised about every 10 years. After a revised COS is released, Japanese elementary schools usually use lesson study with the entire faculty to seek an effective implementation of the new COS. This chapter, based on a case study, documents how Japanese teachers and administrators in a public school work collaboratively to implement the new curriculum through lesson study, and identifies elements that seem important for connecting the curriculum, teachers, and teaching. The results of the study suggest that Japanese educators' use of school-based lesson study is an effective way to implement a new curriculum. Unlike many lesson study projects outside Japan, which are often conducted by a few volunteers within a school and supported externally, school-based lesson study in Japan is a highly structured, collaborative effort of school administrators, teacher leaders, and all the teachers at the school, with additional support from the local district.

Keywords Lesson study · In-service · School-based · Role of administrators · Course of study · Japan · Professional development · Research lesson · Research steering committee

Introduction

Implementing a new curriculum is always a challenge. Mathematics education researchers and educators have been interested in learning from other countries to see how the intended curriculum and implemented curriculum impact student achievement since the First International Mathematics Study (FIMS) was conducted by the International Association for the Evaluation of Educational Achievement (IEA) in 1964. Recent movements toward establishing nationwide common standards in mathematics in the United States have left mathematics educators with the question

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of how to implement the curriculum in every school so that every student is provided an equal opportunity to learn mathematics. This requires a lot of effort, not only to develop good curriculum materials, but also to provide effective professional development programs for the teachers to gain the knowledge necessary for teaching the new curriculum, as well as the expertise necessary to support their students in learning mathematics (Common Core State Standards Initiative 2010; National Mathematics Advisory Panel 2008; Stigler and Hiebert 1999, 2009).

Faced with the challenge of bringing a new curriculum into every classroom, Japanese educators use the lesson study process as a vehicle for professional development and for establishing shared knowledge (Takahashi 2011). Various forms of lesson study exist, including district- and national-level lesson study (Murata and Takahashi 2002; Takahashi 2006). This chapter reports on a case of school-based lesson study at a public elementary school in Tokyo to examine how revisions of the national curriculum, known as the Course of Study (COS), get implemented nation-wide.

About the Study

The study was conducted (1) to document how teachers and administrators in a Japanese public school work collaboratively to seek an effective implementation of the new curriculum through lesson study, and (2) to identify possible elements that seem important to seamlessly connect the curriculum, the teachers, and instruction.

During the 2011–2012 school year, from April 2011 to December 2011, the author visited the school more than ten times to observe and document lesson study activities. These activities included six research lessons and post-lesson discussions, lesson planning sessions during summer break, and the school's public open house at the end of the second year of the school research. Also, the author conducted interviews with the school's principal and assistant principal, the chair of the school research steering committee, and the invited "knowledgeable others" who provided feedback and final comments during the post-lesson discussions. All these sessions and interviews were documented using an audio recorder and field notes. All data from communications and interviews with the subjects were collected and analyzed in Japanese and the results were translated into English by the author. In addition, all lesson plans and internal documents that were directly related to the school-based lesson study project were gathered and analyzed in Japanese.

Background

COS Revision Process and Its Implementation

The Japanese COS has been revised approximately every 10 years since 1951. The latest Japanese elementary school COS was announced in March of 2008.¹ In June of the same year, an elaboration of the COS for elementary schools, *Teaching Guide for the Japanese Course of Study: Mathematics*, was released by the Japanese Ministry of Education, Culture, and Sports. Immediately after its release, school districts provided workshops, attended by representatives of the schools, discussing the major changes in the revision. The districts also assigned selected schools to focus their school-based lesson study on the effective implementation of the new COS. This process occurred while the textbook companies were developing new materials based on the new curriculum. The new COS went fully into effect among all the Japanese public elementary schools in April of 2011 (the beginning of the school year). Thus it took three years for the textbook publishers and schools to fully implement the COS.

During this preparation period, even before revised curriculum materials were available, many schools began to seek effective implementation of the new COS. Schools often conduct school-based research, using lesson study, with the entire faculty. The school districts often provide financial support to the schools and encourage them to host a lesson study open house as the culmination of their school-based research to disseminate their findings to other schools in the district. As a result, some schools in the district have open houses before the full implementation of the COS. These lesson study open houses may include several different subject areas and focus on different changes in the COS.

Role of Lesson Study in Implementing the COS

To support teachers in improving their own teaching and learning, the Japanese school system has a systematic professional development approach called lesson study. It is the most common form of professional development in Japan (Lewis 2000; Lewis and Tsuchida 1998; Murata and Takahashi 2002; Takahashi 2000; Takahashi and Yoshida 2004; Yoshida 1999a). In lesson study, a team of teachers studies the COS, reads research articles, examines available curricula and other materials, and designs a lesson. One teacher from the team instructs the lesson publicly, and the team conducts a post-lesson discussion focusing on how students responded to the lesson, in order to gain insights into how students learn and to find ways to improve teaching.

¹An unofficial English translation of the mathematics curricula in the Japanese Course of Study, including objectives and content for grades 1–9, is available at http://www.seiservices.com/APEC/APEC_KB/KBDisplay.aspx?lngPkID=1567.

During lesson study, teachers have the opportunity to look closely at teaching practices and judge, based on student learning, whether the lesson properly supports the students in learning mathematics. Researchers credit Japanese lesson study with enabling the implementation of new approaches to teaching mathematics (Lewis 2002; Lewis and Tsuchida 1998; Stigler and Hiebert 1999; Yoshida 1999b).

Although lesson study is commonly used as a medium of professional development that focuses on teachers and schools improving their teaching and learning, lesson study is also used to seek practical ideas for effective implementation of curricula (Murata and Takahashi 2002).

During the transition period from one COS to a new COS, the Japanese school system provides a variety of supports for schools and teachers, which include a document that elaborates on the focus and the contents of the COS (the *Teaching Guide* mentioned above), and workshops for administrators, district coordinators, and teacher leaders, which provide further information and examples of the contents of the COS. Commercial publishers, including textbook publishers, release teacher resources, curriculum materials, and sample curriculum maps for teachers. These publishers often work closely with teacher leaders to develop materials before the full implementation of the COS.

Among all of the supports that teachers receive during the transition to the new COS, this study focuses on school-based lesson study, which is one of the major professional development components during this important period. The author started documenting one school's lesson study cycles at the beginning of the second year of the school's lesson study-based research project. The author also closely followed the school administrators to investigate how they worked with members of the school steering committee and chairperson to be sure that the school-based research was conducted properly and effectively.

Major Points of Revision of the 2008 COS

The Ministry of Education released the 2008 COS in response to concerns about declining mathematics achievement due to a severe reduction in content and number of class periods in the 1998 revision. As a result, the 2008 Course of Study returned almost completely to the content and the number of class periods of the 1989 COS. Table 1 shows how the standard numbers of class periods required for mathematics by the law has changed. For teachers who previously taught according to the 1989 COS, this change presented little challenge. On the other hand, younger teachers saw this revision as an overwhelming increase to their workload, and it included some mathematics that they may have never taught before.

Another major change of the 2008 COS was to increase the emphasis on mathematical processes such as thinking mathematically and expressing thoughts using mathematical representations such as diagrams and equations. In order to address this, all classroom teachers are expected to regularly provide each student with opportunities to think mathematically and to express their own thoughts.

Table 1 How the standard numbers of class periods required for mathematics by the law has changed over time

Grade	Age	Standard number of class periods per year for mathematics						
		1951	1958	1968	1977	1989	1998	2011
Elementary								
1	6	77	102	102	136	136	114	136 (4 per week)
2	7	123	140	140	175	175	155	175 (5 per week)
3	8	138	175	175	175	175	150	175 (5 per week)
4	9	160	210	210	175	175	150	175 (5 per week)
5	10	160	210	210	175	175	150	175 (5 per week)
6	11	160	210	210	175	175	150	175 (5 per week)
Lower secondary								
1	12	140	140	140	105	105	105	140 (4 per week)
2	13	140	140	140	140	140	105	105 (3 per week)
3	14	140	105-175	140	140	140	105	140 (4 per week)

Table 2 Number of the students by the grades and the class

	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Special needs
Class 1	36	37	40	31	31	37	13
Class 2	36	36	40	31	30	37	12
Class 3	35	36	40	32	31	37	
Class 4		37		32	31		

To prepare for these radical changes, the Ministry set a two-year preparation period for schools, teachers, and textbook publishers. All public elementary schools in Japan in the spring of 2008 created a professional development plan to prepare for the full implementation of the new COS in the 2010–2011 school year.

The Case

About the School

A public elementary school in Tokyo was chosen for the case study because it is a typical neighborhood school with a diverse student population. As of May 1, 2011 there were 758 students, 397 male and 361 female, from grades 1 to 6. Table 2 shows the number of classes in each grade and the number of students in each class.

Led by the principal and the assistant principal, 64 teachers and staff worked collaboratively to carry out the school's mission. Among these, there were 35 full-time

Table 3 Distribution of the teaching experience among the full time teachers at the school (2012–2013 school year)

Teaching Experience	Number of the full-time teachers
1 year–less than 5 years	7 (20 %)
5 years–less than 10 years	16 (45 %)
10 years–less than 15 years	2 (6 %)
15 years–less than 20 years	3 (9 %)
More than 20 years	7 (20 %)
Total	35

teachers, which included 22 classrooms teachers, 6 teachers for students with special needs, 4 additional teachers who teach special subjects, 2 school nurses, and 1 dietitian who is responsible for the school lunch menu. There were also several part-time teachers working at the school. Table 3 shows the years of teaching experience among the full-time teachers.

Process of School-Based Lesson Study and Its Supporting Structure at the School

Year 1: April, 2010–March, 2011

After the COS revision was announced in March of 2008, the teachers of the school decided to study the major changes in the COS revision and its effective implementation. Of the various subjects, the teachers decided to focus on mathematics. One motivation for this decision was the requirement that students learn an additional 20 % of mathematics content in grades 1–6. The teachers at the school felt that this content increase would mostly impact the teachers with less than 10 years of teaching experience. Since about 65 % of the full-time teachers had less than 10 years of teaching experience, collaboration among novice and senior teachers would be key for the successful implementation of the revised COS. Another challenge in mathematics was the new emphasis on promoting mathematical thinking and exposition. Teachers would need to consider not only how the amount of content changed but also how to design lessons that would push all students to think mathematically and to communicate with each other in such a way as to learn other ways of thinking mathematically.

After deciding to focus on the effective implementation of the mathematics curriculum, the school submitted a request to the local school district board to support this study. The local school district responded by making a small grant to support a public open house at the end of the study to disseminate the results of the school's work.

The school organized a research steering committee (RSC), which consisted of representatives of each grade level and the math teacher who was in charge of supporting other teachers in regards to teaching mathematics. The chair of the committee worked closely with the administrators to arrange logistics for conducting

the school-based lesson study. In order for the faculty at the school to be prepared to begin the school-based lesson study, the RSC began drafting a proposal of the study during the end of the 2009–2010 school year. At the first faculty meeting of the 2010–2011 school year, April 2, 2010, they proposed the following theme and focus:

Research theme: The development of individual thinking and the expression of these thoughts

Focus of study: Seeking effective ways to support students' individual problem solving skills and the ideal facilitation of whole-class discussion in teaching through problem solving

The school research theme was intended to address one of the emphases of the revised COS. The RSC decided to focus on improving the quality of lessons based on problem solving, such lessons having been emphasized in Japanese mathematics education for several decades as a way to foster student mathematical thinking (Takahashi 2008, 2011).

The teachers at the meeting concluded that the proposed theme and focus of the school research would be a good starting point, but would be revisited after several research lessons and post-lesson discussions.

Under this tentative theme and focus of study, the full time faculty members were divided into 8 teams: one for each of grades 1 through 6 plus 2 teams consisting of teachers of students with special needs. During year 1, each team developed a lesson plan for a research lesson and conducted the research lesson and its post lesson discussion to address the theme. All full-time teachers and the school nurse and school dietitian observed the lessons and participated in the post-lesson discussions, so each full-time teacher had the opportunity to be a part of 8 research lessons during the school year. In addition to the 8 research lessons, the school invited two distinguished mathematics educators to give lectures, one in the first month of the school year (April) and another during the summer break, about the issues and trends in mathematics education and ideas for implementation of the new COS.

Based on the approved plan and the schedule drafted by the RSC, each team was asked to decide when the team wanted to have their research lesson. Each team examined the curriculum and the schedule of possible dates, and chose a couple of possible topics that they wanted to study in order to address the theme and focus of the school research. Based on each team's preference, the RSC proposed a schedule that was discussed, revised, and approved by the teachers at the faculty meeting on April 7, 2010. Accordingly, the following events occurred during that first school year:

- Friday, April 9. Demonstration lesson by an invited teacher to raise issues related to the theme and school research focus
- Wednesday, April 21. Faculty meeting to discuss and approve the theme of the school-based lesson study
- Wednesday, May 19. Lecture by a leading math educator on the school research theme

- Wednesday, June 16. Research lesson and post-lesson discussion: “various lengths” for a class of special needs students
- Wednesday, June 23. Research lesson and post lesson discussion: “subtraction (1)” by the grade 1 team
- Friday, August 27 (During summer break). A lecture by a leading math educator on the school research theme
- Wednesday, September 22. Research lesson and post-lesson discussion: “area” by the grade 4 team
- Wednesday, October 27. Research lesson and post-lesson discussion: mathematics for students with special needs by the special needs team
- Tuesday, November 24. Research lesson and post-lesson discussion: “multiples and factors” by the grade 5 team
- Wednesday, November 30. Research lesson and post lesson discussion: “enlarged and reduced drawings” by the grade 6 team
- Wednesday, January 26. Research lesson and post-lesson discussion: “addition and subtraction (2)” by the grade 2 team
- Wednesday, February 16. A research lesson and post-lesson discussion: “math sentences using □” by the grade 3 team.

The teachers at the school shared many responsibilities to make the research lessons and discussions go smoothly. For example, for the research lesson held in June, the grade 1 team developed a lesson plan and taught the lesson based on this plan. During the post-lesson discussion, the grade 4 team facilitated the discussion and the team of teachers of special needs students took notes of the post-lesson discussion for the school’s official record.

One notable activity that launched the two-year research project was the demonstration lesson by an invited practitioner. With more than 30 years of teaching experience, that person is known as a master teacher. The RSC assigned to their colleagues the following four points of focus for their observations during the lesson:

- (1) Ways to organize board writing
- (2) Effective key questions
- (3) Effective ways to develop ideas based on students’ reactions
- (4) Ways to support students in developing the ability to explain their ideas and approaches

In selecting these four focus points, the RSC drew upon articles and resources from journals and reference books of mathematics education. According to the chairperson, the RSC hypothesized that having these four focus points would help the faculty develop a shared view about the way in which they might address the school research theme and develop students’ ability to come up with their own thinking and to express their thoughts.

From the shared observations and discussions, the school developed a draft concept map of the research theme and focus. The RSC used this draft as a foundation for two years and finalized a concept map as a result of their research. The concept map was included in the research report as the Structure of the Overall Research and was distributed to other schools in the district (see [Appendix](#)).

Year 2: April, 2011–March, 2012

The second year of the research program was mostly similar to the first. One major difference between year 1 and year 2, however, was that the schedule in year 2 had a public open house scheduled near the end of the school year, December 1. Having a public open house to disseminate the results of the school's research project is common practice among Japanese public schools. In order to have this event, the school had to complete all research lessons by the middle of the fall and compile their findings as much as possible a few months before the open house. This made the school schedule rather inflexible.

At the first faculty meeting of the 2011–2012 school year, on April 6, 2011, the RSC proposed a change in the research theme based on their reflections on the first year's activities. The first year's theme had emphasized the development of individual students' ability to think and express their thoughts. Now the teachers felt that students were not appreciating the benefits of collaboration—learning from others' ideas and developing better ideas by exchanging and combining ideas. This led to the following new research theme:

Research theme: Mathematics teaching that helps students explain their ideas to each other and learn from each other—learning through problem solving

At the same meeting, the faculty also approved the following schedule of activities for year 2, which the author participated in and documented using field notes:

- Wednesday, April 6. Faculty meeting to discuss and approve the modified theme of the school-based lesson study and set the schedule of research activities
- Friday, April 8. Workshop by a leading math educator about effective lesson observation
- Wednesday, April 20. Research lesson and post-lesson discussion: “symmetry” by the grade 6 team
- Wednesday, April 27. Lecture by a leading math educator
- Wednesday, May 11. Research lesson and post-lesson discussion: “angles” by the grade 4 team
- Wednesday, May 18. Research lesson and post-lesson discussion: “multiplication of decimal numbers” by the grade 5 team
- Wednesday, June 13. Research lesson and post-lesson discussion: “division” by the grade 3 team
- Wednesday, June 21. Research lesson and post-lesson discussion: “subtraction” by the grade 1 team
- Friday, Aug 26. Grade band meetings for developing lesson plans for the public research lessons at the public open house.
- Wednesday, Sep 14. Research lesson and post-lesson discussion: “addition and subtraction” by the grade 2 team
- Thursday, Dec 1. Public open house.

In addition to these events, the RSC met several times between the research lessons to summarize the ideas that had been proposed by each lesson planning team and addressed during the post-lesson discussion. This was done to make sure that individual learning was consolidated and shared among all teachers at the school. The summary of the RSC's effort was published as a school research newsletter each month. Besides documenting the process of this long-term collaborative effort, these newsletters allowed the teachers to share what was discussed and helped the later teams build off the results of the previous research lessons.

The Structure of the School Research Organization and the Role of the School's Research Steering Committee (RSC)

During the two years of the school research program, all full-time teachers at the school worked within a structure based on existing grade-level groups. Grade-level groups typically exist in Japanese elementary schools to facilitate the sharing of responsibilities for running school events and for academic activities. These responsibilities include preparing curriculum materials for the teachers in the grade to use, preparing school events such as the sports festival and open houses, and planning and conducting events organized by each grade such as field trips and teacher-parent conferences. Most public schools have scheduled time for grade meetings in their weekly schedule, typically about one hour, and have desks in a common work area so that the teachers who teach the same grade level can easily collaborate on a regular basis. It was natural to build off this existing collaborative structure for the school-based lesson study work, and so each grade level group was made responsible for designing a lesson plan for a research lesson, preparing the research and the post-lesson discussion, and supporting the other teams' research lessons. The overall structure of the school research organization is shown in Fig. 1.

Although each grade team developed its own lesson plan, each lesson plan was expected to address the school research theme and to help develop shared approaches to effectively implementing the new curriculum. The RSC had the important responsibility of maintaining cohesiveness of ideas in the lesson plans across the grades.

The RSC comprised a teacher from each grade group, nominated by that group, and a chairperson appointed by the school administrators. According to the principal, the chair was chosen based on his leadership ability and his knowledge of mathematics teaching and learning. The RSC chair was one of the full time special subject teachers at the school, normally in charge of supporting upper grade classroom teachers in teaching mathematics and preparing curriculum materials for the school. As chair, his primary role was to lead the school research in order to maximize teacher collaboration to accomplish the research goals. The chair led the RSC to complete the following tasks:

- Communicate regularly with the principal and the assistant principal to develop a master plan for the school research that included the effective use of resources including time and budget

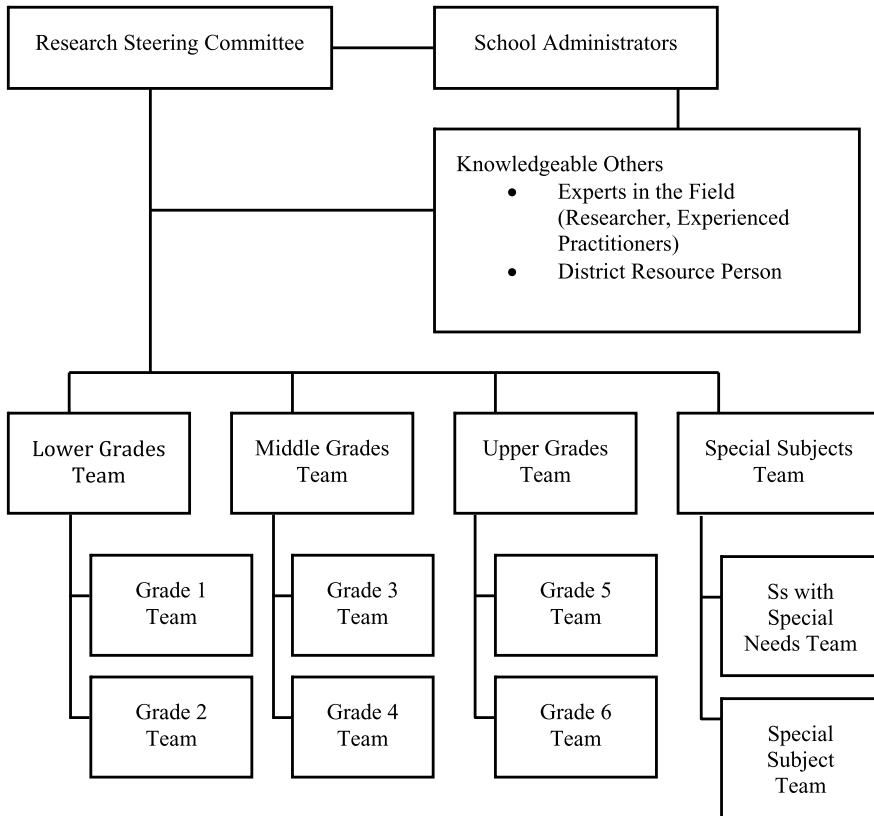


Fig. 1 Structure of the school research organization

- Schedule and lead the monthly RSC meetings to find strategies to address the theme of the research based on the ideas of the teachers
- Lead the preparations and oversee each school research activity such as research lessons and lectures
- Publish a monthly internal newsletter to update the findings of each research lesson and to share important ideas and information for carrying out research activities
- Plan, edit, and publish the school research reports, including the publications for the open house
- Communicate with knowledgeable others for the effective use of their expertise.

As Fig. 1 shows, the school also had the grade-band teams, which consisted of all the teachers from adjacent grades, such as grade 1 and grade 2. The major role of these teams was to discuss and implement strategies proposed by the RSC in each research lesson. Although the responsibility for lesson planning belonged to each grade group, most of the lesson planning was done in grade band meetings,

since the teachers felt that the grade level groups, comprising only 3 or 4 teachers, were too small on their own to generate enough variety of ideas to lead to good research lessons. Also, the grade band meetings helped the teachers develop a shared view not only of their students but also of the scope and sequence of the curriculum in adjacent grades, which is important since Japanese elementary school teachers typically teach the same students two consecutive years. Finally, the grade band meetings also provided additional opportunities to participate in research lesson planning, a valuable experience especially for novice teachers not only to learn how to design lessons but also to deepen their understanding of the topics they teach through *kyozaikenkyu* (Takahashi et al. 2005; Takahashi and Yoshida 2004; Watanabe et al. 2008). In these ways, the grade-band teams were a crucial piece of the overall structure supporting the school's lesson study research.

Lesson Plans and Their Development

Based on the faculty's reflections from the year 1 research activities, the RSC provided guidelines for preparing research lessons and lesson plans. Their objective was to aid two new teachers who had joined the school in year 2 and who had little experience with systematic school-based research. The guidelines were as follows:

An example of preparing a research lesson

- (1) Decide on the topic of the research lesson and who will teach the lesson. Develop a rough idea of a lesson plan and conduct *kyozaikenkyu* related to the topic.
- (2) **Three weeks before the research lesson:** The first lesson-planning meeting is held to discuss the rough draft to check for consistency with other grade groups' approaches.
- (3) Develop the first draft of the lesson plan based on the discussion at the first meeting.
- (4) **Two weeks before the research lesson:** The second lesson-planning meeting is held to discuss the lesson plan and the team's focus strategies.
- (5) Update the draft lesson plan and the focus strategies.
- (6) **One week before the research lesson:** Finalize the lesson plan and send it to the invited final commentator of the research lesson (the knowledgeable other) via express mail, including a handwritten letter by the teacher who will teach the lesson.
- (7) Print the lesson plan. Share the tasks needed to prepare for the research lesson, including the preparation of materials such as manipulatives, posters, and worksheets.
- (8) **On the day of the research lesson:** Conduct the research lesson and the post-lesson discussion. Support the teacher who teaches the research lesson.

Note: Although each grade group is mainly responsible for the preparation and execution of its lesson, the above preparations should be done through the grade band team's collaboration.

Based on these guidelines, each grade group planned a research lesson once during the year. So each teacher was responsible for writing one lesson plan as a member of a grade group and also had the opportunity, as a part of a grade-band team, to be a part of the lesson planning discussion of another grade.

In each stage of lesson plan development, the chair and members of the RSC reviewed the lesson plan and provided feedback to the team. Through this process, the RSC tried to ensure that the lesson plans were of sufficient quality to merit discussion by the entire faculty and contributed to the school's effective implementation of the COS. But, according to the school principal, the quality of the research lesson plans in year 1 was not satisfactory. Based on the principal's suggestion, the RSC developed the following list of criteria for lesson plans and distributed it to each teacher at the beginning of the year 2:

- Does the lesson plan provide sufficient information for the reader to understand the task and the flow of the lesson?
- Does the lesson plan provide sufficient information about how the planning team decided to teach the lesson as described by the plan?
- Do the objectives of the lesson plan clearly address the COS?
- Are the tasks appropriate for the students given the date of the lesson?
- Are the key questions clear? Will they push students to think mathematically and help them complete the task independently?
- Does the lesson plan include reasonable anticipated student responses and indicate how the teachers will help students overcome any misunderstandings?
- Does the lesson plan include a plan for formative assessment and a plan to accommodate individual student differences during the lesson?

These criteria were used not only by the RSC in reviewing the draft lesson plans but also by the teachers themselves during the planning meetings. According to the principal, the lesson plans that were developed for research lessons in year 2 reflected much deeper thought compared to the plans developed in year 1.

One of the unique features of this school's research lesson plans was the inclusion of a two-page summary. Typical research lesson plans are several pages in length—they sometimes run more than ten pages. Faced with such a lengthy plan, teachers with less lesson study experience sometimes have difficulty comprehending the important points of the lesson and preparing to observe it effectively. Also, the final version of a lesson plan was usually distributed to the faculty a day prior to or in the morning of the research lesson, which meant that teachers did not necessarily have a lot of time to read it carefully. So the school decided to include a short summary to help teachers with less experience and teachers cramped for time easily understand what he or she should be looking for while observing the research lesson.

Organization of the Research Lesson and Post-Lesson Discussion

Although each teacher had only one chance each year to develop a lesson plan for a research lesson, he or she had eight opportunities each year to observe a research

Table 4 Schedule for a research lesson and post-lesson discussion

1:30–2:15	Research Lesson
2:20–2:40	Small Group Discussion (Grade Band Teams)
2:40–3:45	Post-Lesson Discussion (Entire Faculty)
3:45–4:30	Final Comments by a Knowledgeable Other
4:30–4:45	Summary and Next Steps

lesson and discuss the effectiveness of the implementation of the COS. This is a major advantage for teachers of school-based lesson study.

In order for all faculty members at the school to observe these research lessons, the school scheduled most research lessons on Wednesdays. Similar to most public schools in the area, the school scheduled special events every Wednesday afternoon so that students can be dismissed early if necessary. The school used Wednesday afternoons once a month for the research lessons. On the day of the research lessons, all of the classes were dismissed immediately after lunch except the class with which the research lesson would be conducted. In this way, the school freed teachers to observe the research lesson. Table 4 shows the schedule followed by the school on those Wednesday afternoons.

Typically, a post-lesson discussion with the entire faculty is held immediately after the research lesson. The school decided, however, to first hold small-group discussions in grade band teams as a way to provide more opportunities for each teacher, especially for the novice teachers, to share their ideas. In the past, some teachers at the school seemed reluctant to share their honest opinions at the post-lesson discussion because it was formal and in front of the entire faculty. The small-group discussions usually lasted about 20 minutes and were led by the RSC members. The discussions were summarized on small posters and were shared at the beginning of the full faculty discussion.

The full faculty discussion usually began with the principal introducing the final commentator, or knowledgeable other. Then the moderator, a member of a different grade-level team, would invite each grade band to share the issues they identified during the small group discussions. The discussion then focused on how the lesson plan could be improved. In the first year and the beginning of the second year, the discussions were not so active, and only the members of the RSC contributed observations and thoughts about how the lesson plan could be improved. But by the fourth research lesson in June 2011 the dynamic was changing and more teachers, including new teachers, began to contribute to the discussion.

At the end of the discussion, a knowledgeable other, invited from outside the school, would provide a summary of the discussion and offer suggestions not only for improving the particular research lesson from that day but also for carrying out the school research. The school made use of several knowledgeable others over the two-year period, inviting them based on their schedule and the topic of the research lesson, with a few of them giving comments several times. The knowledgeable others were instructional leaders from the area with more than 30 years of teaching experience.

After the final comments by the knowledgeable other, the assistant principal at the school usually offered a summary of the research lesson and its post-lesson discussion by highlighting the issues that were discussed and the major points that all the faculty members should keep in mind in designing future lessons. The assistant principal then formally concluded the discussion by thanking the knowledgeable other, the team who developed the research lesson, and the teacher who taught the research lesson.

Although the post-lesson discussion was at that point formally closed, and the knowledgeable other and administrators left the meeting room, the entire faculty remained to summarize their learning and to discuss next steps. This discussion, usually led by the chairperson of the RSC, helped ensure that each research lesson was not an isolated event, and helped maintain the cohesiveness of the school research. The RSC representative from the group responsible for the next research lesson was specifically charged with making sure that the next lesson would address issues from the discussion.

Disseminating the Results of the School Research

The school used two conduits to disseminate the results of its research: a public open house that offered live research lessons, and a research report published at the end of the two-year project.

Public Open House

The school hosted a half-day public open house on the afternoon of December 1, 2011. All of the district content specialists and principals of other area schools were invited to the open house, and many other schools sent their teachers to the open house. In all, a total of 612 participants, including teachers, administrators, educators, and parents attended. Among these participants, about 60 % of the participants were teachers, administrators, and educators, 35 % from the district and 24 % from outside of the district. Clearly, this school-based research project attracted many educators. According to the participants, one of the major reasons for them to come to the open house was to see the implementation of the revised COS in action. Since all grades from grade 1 to 6 held research lessons on the day, participants could choose which research lesson or lessons they wanted to see from a wide variety of topics and grades. Also notable is that 160 parents came to the open house, about 20 % of the number of students at the school. Parents came to see what the teachers at the school do to improve their teaching. According to the principal, involving parents in the open house builds strong support from the parents even though the open house is designed for professional educators and teachers. Other participants of the open house included people from the local neighborhood, textbook publishers, and retired teachers of the school. Table 5 shows the breakdown of participants.

Table 5 Participants at the public open house on Dec. 1, 2011

Type of participants	Number (%)
Invited guests	23 (4 %)
Administrators from the schools in the district	38 (6 %)
Teachers from the schools in the district	180 (29 %)
Teachers and educators from outside of the district	146 (24 %)
Parents of the school	160 (26 %)
Others	65 (11 %)
Total	611 (100%)

The public open house consisted of three major parts: public research lessons, research presentations by the school's RSC, and a panel discussion by experts in the field of mathematics education who had been involved with the school's research project. The schedule of the open house was as follows:

- 1:10–1:40 Registration
- 1:40–2:25 Research lessons in 25 mathematics classrooms, including four mathematics classes for the students with special needs
- 2:25–2:40 Break
- 2:40–3:15 Research presentation in the gymnasium
- 2:15–4:25 Panel discussion by the knowledgeable others
- 4:25–4:30 Closing remarks by the principal

There were 28 mathematics lessons based on 25 different lesson plans available for the participants to observe at the beginning of the open house. All 25 lesson plans were distributed as a booklet to each participant at registration. The participants were thus able to witness strategies for the effective implementation of the COS in live lessons and were able bring these ideas back to their school as a set of lesson plans.

The presentation given by the members of the RSC informed participants about the philosophy and the rationale behind the strategies for implementing the new COS at the school. The presentation also provided educators from other schools an opportunity to learn how the school conducted its research using lesson study and what the faculty at the school learned.

The panel discussion provided a broad view of the issues and trends in implementing the COS at schools in the area. Because the panelists had served as knowledgeable others for other schools, they were able to highlight unique features of the strategies that this school had come up with through their two-year collaborative efforts and how other schools might adopt these ideas and strategies.

Research Reports

Two sets of research reports were made available for teachers and administrators of other schools as summaries of the school research effort of year 1, 2010–2011,

and of year 2, 2011–2012. Since the school used a district grant to produce them, all the research reports were available free. For the summary of year 1, the school compiled one booklet of 102 pages, which included:

- (a) the rationale behind the school’s choice of research theme;
- (b) a concept map of the research theme and focus;
- (c) a report on each research lesson, which included the unit plan, lesson plan, and summary of the post-lesson discussion; and
- (d) a summary of an assessment of student attitudes and achievement.

In the second year, the school compiled a report covering the entire two-year study. The report was produced as four booklets: three of them were distributed at the public open house and the last was sent to all the schools in the district at the end of the 2011–2012 school year:

Distributed at the public open house:

1. The school research report² (20 pages)
2. Lesson plans for the research lessons at the open house lessons (16 lesson plans, 38 pages)
3. Two-page shortened versions of lesson plans of all the research lessons from the two years of the school’s research (20 lesson plans, 46 pages)

Distributed at the end of the school year 2011–2012:

4. Report of the public open house comprising reports of each lesson at the open house (28 lesson reports, 57 pages).

According to the principal, these reports, with their large number of lesson plans for all the elementary grades, are not meant to be a collection of best practice. They are expected to be a resource for teachers in the district to draw from as they engage in their own study about effectively implementing the COS. Thus these reports include not only lesson plans but also reflections of the teachers, sharing what they learned from the research lessons. The reports make it clear that the teachers at the school used lesson study as a way to examine their knowledge, ideas, and practice for teaching mathematics—not as a way to come up with perfect lessons.

Findings

In addition to his observations during the second year of the program, the author conducted interviews that provided insights into the thinking of the school administrators and how the project impacted teachers. Based these interviews and on his own observations and those of the persons interviewed, several factors stand out as

²An English translation of this report is available for download at <http://www.impuls-tgu.org/resource/readings/page-26.html>.

important to the effectiveness of this project for preparing the teachers to implement the new Course of Study. They are: leadership by the administration and Research Steering Committee; the deliberate importation of new knowledge and ideas from outside; structures to support collaborative learning; and the lesson study process itself.

Shared Leadership

Lesson study has been described as “teacher-led professional development.” In this school-based LS project, teachers led the way by developing research lessons in which they proposed and tested strategies for solving common problems. Teachers also took turns handling the logistics of their colleagues’ research lessons by facilitating the discussion or taking notes. But important leadership also came from the administration and from the RSC, sometimes “behind the scenes” and sometimes overtly.

Administration

As is common practice, the school made use of the existing grade-level teams as the primary organizational structure for its lesson-study work. When they were making grade-level assignments of teachers, the administrators carefully distributed experience and expertise among the grade-level teams.³ This meant that each grade band had the teacher leadership needed to conduct thorough *kyozaikenkyu* when developing its research lesson plan.

Even with this distributed knowledge and expertise, the administrators still felt it was important to attend some of the lesson planning meetings as an instructional leader. According to the assistant principal, they attended the lesson planning meetings in order to gauge the teachers’ understanding of the content that they planned to teach. He believes that the quality of the lesson plan hinges on the level of understanding of the content and the curriculum. If a team was struggling to understand what the major point is and why students need to learn it, he offered some suggestions. But, to preserve the teachers’ sense of ownership, he tried not to provide suggestions too often. The assistant principal said, “We need to carefully monitor what teachers are thinking in order to provide sufficient support. We do not want to give too many suggestions to the teachers. This is just like teaching students mathematics.” The assistant principal carefully reviewed all lesson plans line by line before they were finalized.

³Japanese teachers usually teach a different grade in each year. Classroom teachers often teach the same students multiple years, typically two years. They may request their preferred grades, but the principal makes the final decision.

Another important role for the administrators is to bring knowledgeable others with strong teaching backgrounds who can best help the school address their research theme. Among various experienced educators, such as university professors, leading practitioners, and retired principals, the administrators chose people whom they had seen fill the knowledgeable other role well and who also fit the school's particular needs. As a result, some knowledgeable others were invited several times and some were invited just once during the two years.

Finally, the administrators exercised their leadership through their own participation in the research lessons. The author has never seen any research lessons at the school conducted without the presence of the administrators. Either the principal or the assistant principal—and usually both—observed each research lesson from beginning to end and contributed comments during the post-lesson discussion. Then the principal joined with the planning team, the chair of the RSC, and the knowledgeable other in an in-depth meeting to consolidate the important insights or ideas to carry forward from the research lesson.

Many teachers at the school agreed that hard working teacher leaders and administrators were the key to the success of the school research. According to the principal, school-based lesson study never succeeds if the school administrators are not part of lesson observation and discussion. But for them to make positive contributions, the administrators and teacher leaders should be experts in teaching and learning of the subject matter, or at least be keen about improving teaching and learning for the students at the school, and genuinely interested in studying the students' learning process.

Research Steering Committee (RSC)

Perhaps ironic, one of the most important leadership actions by the administration was to devolve leadership to the teachers by creating a Research Steering Committee. Led by the chairperson, the RSC played an important role in leading the school research project and supporting each team's lesson study effort. Although the chairperson was appointed by the administrators, the committee consisted of representatives of each grade band. The RSC functioned as the hub of interaction among teachers and the driver of the school-based lesson study project. According to the principal, establishing a research steering committee is typical practice among schools in Japan.

The major role of the RSC was to solicit ideas from teachers and make sure that what was learned through the two-year project was shared across the school. That shared knowledge included a deeper understanding of the mathematics that they teach based on the COS, pedagogical ideas for addressing their students' needs, and ideas for improving teaching and learning in general.

The RSC assumed the following responsibilities during the two-year research project:

- Created a draft research proposal with theme and research focus;
- Created a draft calendar of events;
- Created a guideline for the lesson planning process;

- Created criteria for lesson plans as a way to improve their quality;
- Synthesized important points from each post-lesson discussion, published them in a newsletter, and explicitly directed later planning teams to address them, helping to keep the school research program coherent and moving forward;
- Produced the reports at the end of the first and second years.

In addition to these responsibilities, the chair and members of the RSC put a great deal of effort towards facilitating the transfer of ideas and strategies from one research lesson to later research lessons. By its nature, the process of lesson study—planning lessons together and observing the results with their own students—helps create shared knowledge. But the principal argues that the benefits of lesson study can dissipate without regular efforts to summarize teachers' learning. Even though planning teams worked toward a shared objective, if each lesson were built from scratch using the team's unique ideas and strategies, there was significant risk of ending up with an incoherent set of ideas and strategies for implementing the new COS. To keep the work coherent and progressing forward, the school administrators and the chair of the RSC had regular meetings between the research lessons to discuss what knowledge should be shared and what actions might be needed next. The chair of the RSC distributed a monthly internal newsletter based on these meetings to all teachers summarizing what they learned from each research lesson and post-lesson discussion. The RSC also reminded each planning team to address issues from previous lessons.

So administrators and teachers, through the RSC, each played their part in guiding the lesson study project. According to the principal, it is crucial for successful school-based lesson study to plan for this kind of shared responsibility.

Pathways of New Knowledge and Ideas

Even if teachers work hard to seek ways to effectively implement the COS, it is not always realistic to expect them to come up with good strategies without having deep subject matter knowledge or without a broad awareness of issues in improving teaching and learning. According to the assistant principal, the successful implementation of the COS hinges on each teacher's understanding of the contents that they teach, so that they can teach mathematics using textbooks rather than teaching the textbooks (Takahashi 2011). To do this, each teacher must understand what the key elements are in each lesson and why students need to understand them.

The main way teachers develop their understanding of the content they teach is through *kyozaikenkyu*, the careful study of materials for teaching. But some teachers are not accustomed to practicing careful *kyozaikenkyu*. From the administrators' perspective, an important long-term outcome of the school research project would be that teachers would conduct rich *kyozaikenkyu* when preparing their everyday lessons. Thus the planning of the research lessons, the teaching of the lessons, and the post-lesson discussions were not just about the issues explicitly addressed in those lessons, but were also about providing teachers with experiences that would improve their everyday *kyozaikenkyu* and lead to better teaching overall.

The plan created by the RSC was designed to provide teachers with those experiences, and administrators and the RSC monitored the various research activities and provided additional support when necessary. The administrators also took additional actions to enrich the experiences teachers had from the project.

Requesting Support from the District When they make grants to support school-based lesson study, local school districts routinely provide awarded schools prioritized access to a district curriculum coordinator, and funds for extra resources. The funds can be used not only to purchase books and journals but also to invite outside experts to the research lessons and workshops. Schools also receive additional support from the district to conduct one or more public open houses and to publish the results of their study, to be distributed to all the schools in the district.

Using the district support, the RSC at this school collect resources that were related to the theme of the school research. The district funds also made it possible to have knowledgeable others come more frequently than normal; the administrators worked with the RSC to find appropriate knowledgeable others to serve as lecturers or final commentators for the research lessons.

Hiring Teachers with Experience Between year 1 and year 2 of the school based research project, the school hired some new teachers with strong subject knowledge, including knowledge of the new COS, and with leadership experience. The addition of these teachers gave other teachers more access to high quality lesson study experience and, according to the principal, raised the level of discussion during lesson planning meetings.

Collaborative Structure to Support Teacher Learning and Growth

As is often done, this school used their existing grade-level groups for research lesson development and as the core of the research project. In addition, the school added the grade-band teams and the RSC as additional structures for better communication throughout the school. The grade-band teams leveraged the limited number of experienced teachers at the school, providing all teachers access to the knowledge of those experienced teachers when designing lesson plans. According to the assistant principal, the idea was to ensure that all teachers, novice and experienced teachers alike, would have multiple paths of access to the knowledge held within the school. For example if a teacher had a question regarding everyday classroom instruction, he/she could ask it during a grade level meeting. If the question were related to specific subject matter, he/she could ask a member of the grade band team. If the question were related to a broader issue of teaching mathematics, the RSC could help direct it to the most knowledgeable teacher at the school or to outside experts. According to the principal, administrators often use a school research project as an opportunity to establish a collaborative structure if the school does not already have one.

The collaborative structures seemed to have the desired effects. Several novice teachers at the school reported that planning a research lesson with their colleagues

using the guidelines that the RSC provided helped them learn how to conduct *kyozaikenkyu* in their everyday planning. Also, working with experienced teachers when planning the lesson for their grade-level group research lesson greatly helped them to learn about the different kinds of resources that were available at the school and how to use them when planning the lesson. As a result they gradually developed a habit of thinking about the objective of the lesson in relation to the COS and how to support students in accomplishing the objective.

From those comments, it can be concluded that using existing grade-level groups as a foundation is an effective way to reinforce a collaborative environment among teachers at the school. Because the teachers could discuss not only the research lessons they planned together but also, with the same group members, issues in everyday teaching, the knowledge and ideas that arose out of the school research project carried over into their conversation of everyday teaching. One classroom teacher reported that the nature of conversation at the regular grade level meetings shifted to focus more on what the differences of expectations were between the previous COS and the new COS. When discussing topics new to the COS, teachers worked together to study resources such as the official teaching guide of COS (Ministry of Education 2008), teacher journals, and lesson plans published by commercial publishers.

The Value of Lesson Study

The research lessons, the core activity of lesson study, are a particularly visible feature of school-based lesson study, but other features are important for supporting steady progress toward implementing the COS. The school has to have a long-term, well-planned timetable for the school research, a structure to support teacher collaboration, and pathways to bring updated knowledge of the curriculum and key ideas for its implementation.

The school used lesson study as the fundamental process for addressing the challenges of implementing the new COS. It is worth considering what can be learned about lesson study itself from this project.

Each teacher was deeply involved in planning only one research lesson per year. This may not seem like enough to support the changes needed for implementing the new COS, but the lesson study process afforded other opportunities to learn. Teachers observed each other's lessons and discussed the issues. Each teacher at the school also had at least two opportunities to critique lesson plans from another team during the planning process through the grade-band meetings. Finally, teachers observed and discussed the lessons of all the other grades at the school. These additional opportunities may have contributed at least as much to the teachers' learning as did their work on their own research lesson.

Lesson study outside of Japan may often focus too much on the teacher who teaches the research lesson and on the team that plans the lesson. Lesson study can be powerful even for teachers who just observe the research lesson and participate

in the post-lesson discussion. Thus it may be equally important to think about how to maximize the learning opportunity for the research lesson participants.

Successful school-based lesson study requires leadership for creating a long-term plan connected to a broader perspective of improving mathematics teaching and learning, and for supporting teachers' efforts strategically. Although the administration plays an important leadership role, one of the most important tasks of the administration is to cultivate leadership among the teachers, such as by creating a research steering committee and by deliberately distributing more experienced teachers across the grade levels. The administrators and teacher leaders also need to think about how to create long-term pathways for bringing in new ideas and knowledge, such as by creating a norm of conducting thorough *kyozaiikenkyu*. Finally, it is important to think about how the lesson study activities can benefit teachers beyond those on an individual planning team.

Summary

The new COS presented two significant challenges in mathematics for schools throughout Japan: an increased amount of content and a new emphasis on promoting mathematical thinking and exposition. At the same time, many schools had a significant number of teachers retiring and being replaced by novice teachers year after year. At the school examined in this chapter, the faculty and leaders made a decision to address these challenges together through a rigorous, 2-year school research project based on lesson study.

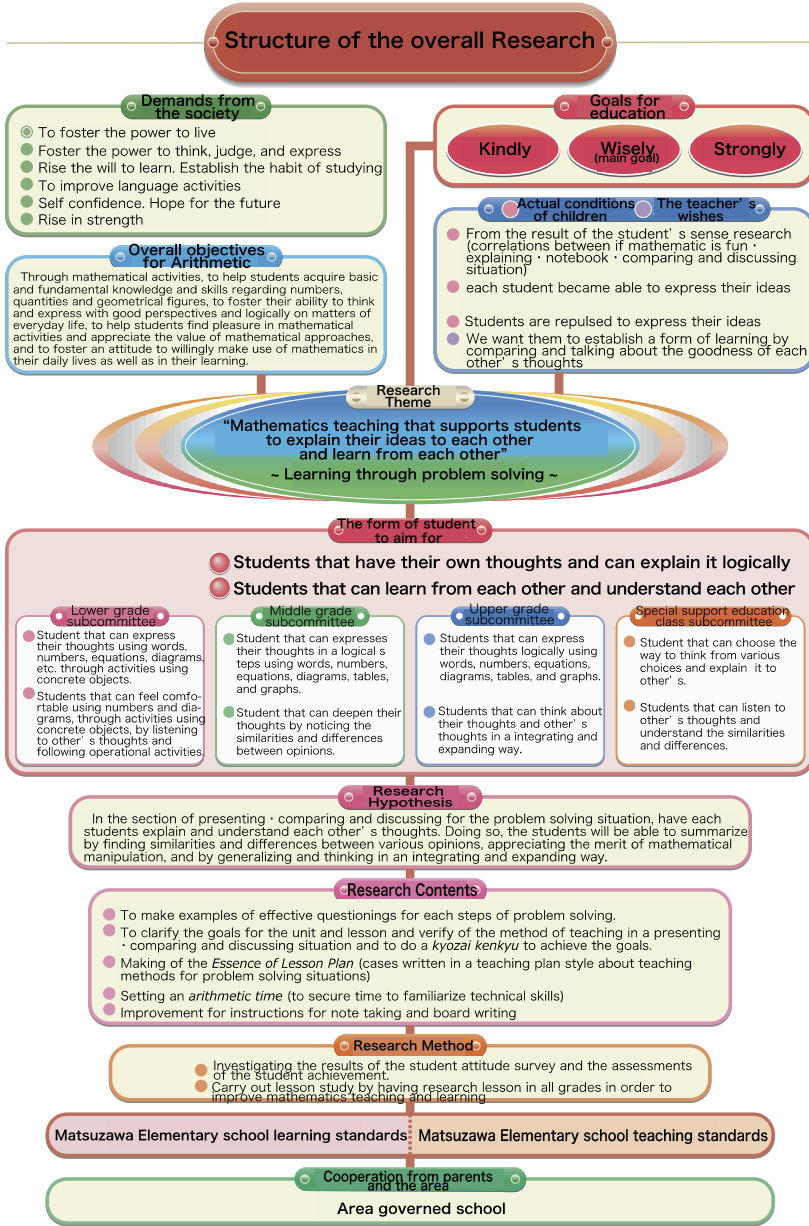
Outside Japan, lesson study has been introduced as teacher-led professional development. In the U.S. and perhaps elsewhere, many lesson study projects have been conducted by a few volunteers within a school with support from outside the school. In contrast, this case study shows that school-based lesson study in Japan is a highly structured, collaborative effort of school administrators, teacher leaders, and all the teachers at the school, with additional support from the local district.

School-based lesson study involves a significant amount of interaction and collaboration among the teachers at the school. There are several levels of meetings included in the school schedule for school-wide study and to prepare for each public research lesson. In addition, many informal voluntary meetings occur. The school administrators also have frequent meetings with teacher leaders to share ideas and concerns in order to make sure all the teachers are progressing toward their common goal. The school administrators and the RSC members of the school frequently communicated with outside experts not only when conducting research lessons, but also when the teachers were preparing lesson plans for their research lessons.

Although this is a single case from one Japanese public elementary school, it illustrates how the staff of a school can work together toward an effective implementation of new standards.

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Appendix: Concept Map of the Research Theme and Focus (English translation by the Project IMPULS at <http://www.impuls-tgu.org>)



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