MIDDLE AND SECONDARY PRESERVICE MATHEMATICS TEACHERS' COMPARATIVE ANALYSIS OF TIMSS VIDEOTAPE LESSON STUDY

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ABSTRACT:
International comparative studies revealed that US students' mathematics performance is not at the level of expectation of mathematics education community. The latest of such study is, Third international Mathematics Science Study-Repeat (TIMSS-R, 1999) continued show poor performance of US students in international arena. Total of 38 countries had participated in TIMSS-R and focus was the mathematics achievement of 8th graders. In TIMSS video study only 6 counties participated along with the US. Five participated in TIMSS 1999 video study outperformed the US in mathematics achievement. Since the teachers and their decisions on teaching plays significant role in students learning, future US mathematics teachers can learn from accomplished practices in international arena. The purpose of this study is to investigate preservice teachers' analyses of such practices. The study is qualitative in nature. Data collection included students' written analyses on videotaped lessons and follow up interviews.

Key words: Video Cases, Teacher Education, Preservice Teachers, Computers in Education

INTRODUCTION:

This presentation focus is a research study focusing teaching and learning mathematics in different cultures and pre-service mathematics teachers' analyses and syntheses of such practices. The comparative nature of this study tends to bring attention of future mathematics teachers to the ways in which how their international counterparts practice. TIMSS 1999 video study brought attention of researchers all over the world since it provides rich source of information about what goes on inside eight-grade mathematics classroom in different nations. (Stigler &Hiebert, 1999; Hiebert, Gallimore & Stigler, 2002; Hiebert at al. 2003). Primary analyses of these data by using qualitative and quantitative methods to explore the mathematical content of lessons, the organization of instruction, instructional processes, and teachers and reform, among other things was done by Stigler et al. (1999). Growing number of researchers (see Chokshi & Fernandez, 2004; Fernandez, 2002; Fernandez, Janon , & Chokshi, 2003; Hollingsworth, Lokan & McCrae, 2003; Kelly, 2002; Klime & Baumert, 2001; Watanabe, 2003) also continued to investigate same data for secondary analyses. All of these analyses done by the experts in the field, none of such studies concentrated on what can future mathematics teachers learn from it. Thus purpose of this study is to investigate future mathematics teachers' learning from TIMSS 1999 video lessons by analyzing and reflection on teaching in different cultures. All six countries (Switzerland did not participate in the TIMSS 1999 assessment) participated in TIMSS 1999 video study outperformed the US in mathematics achievement (see Table-1).

RATIONALE AND LITERATURE REVIEW:

For many years now the International Association for the Evaluation of Educational Achievement (IEA) has conducted several international comparative studies of the mathematics and science performance of students around the world. Third International Mathematics and Science Study-Repeat (TIMSS-R) was conducted in 1999, in which U.S. students scored below the international average at all grade levels on problem solving. (McIntosh & Jarrett, 2000). National Council for Teachers of Mathematics (NCTM, 2000) sees problem solving at the very heart of mathematics and recommends that problem solving be the focus of mathematics education. TIMSS 1999 video study is follow up study and expansion of TIMSS 1995 video study. The TIMSS 1999 Video Study, in addition to the United States, participating countries included Australia, the Czech Republic, Hong Kong SAR, Japan, the Netherlands, and Switzerland. Students in these countries were generally among the top-performing students on the TIMSS 1995 mathematics assessment and, in particular, outperformed their U.S. counterparts.

There is a grooving interest in multimedia, especially use of videos, in teacher education and research. (Anderson ,1998; Hewitt et al. 2003; Masingila, Ochanji, and Pfister , 2004; Stephens et al. 1999; Wang & Hartley, 2003; Van Den Berg, Jansen, & Blijleven, 2004).

Furthermore, accomplished practices from different nations may have potential to broaden future mathematics teachers about learning and teaching mathematics. Along with the experts' analyses, there is a need to document US prospective and practicing teachers' ideas, beliefs and reflections on regarding how top performing countries teachers' teach.

As Stigler and Hiebert (1999) points out "One of the advantages of comparing activities across cultures is that we can see things we might never have noticed had we looked within our own culture" (p.55).Such activities also have significant potentials for both prospective and practicing mathematics teachers' to improve teaching. This is a part of larger project, the study we report here was with prospective teachers.

Table-1(*): Average scores on TIMSS 1995 and TIMSS 1999 mathematics assessments of countries participating in the TIMSS 1999 Video Study

Country	1995	1999
Australia (AU)	519	525
Czech Republic (CZ)	546	520
Hong Kong SAR (HK)	569	582
Japan (JP)	581	579
Netherlands (NL)	529	540
Switzerland (SW)	534	—
United States (US)	492	502
International average	—	487

(*)This table is retrieved from the NCES web site: *http://nces.ed.gov/timss.*

By studying nationally-representative samples of eighth-grade mathematics lessons, the TIMSS 1999 Video Study provides educators and policymakers a better understanding of how national, regional, and local policies related to curriculum and instruction are being implemented in the classroom (Stigler, & Hiebert, 1999). TIMSS 1999 Video Study conducted to; a) To develop objective, observational measures of classroom instruction to serve as appropriate quantitative indicators of teaching practices in each country, b)To compare teaching practices among counties and identify similar or different lesson features across counties and; c)to describe patterns of teaching practices in each country(Hollingsworth, Lokan & McCrae, 2003, pp.1-2)

According to Stigler et al. (1999) using videotaped lessons as a data has some advantages, "The benefits of video are well worth the methodological challenges…Video data are relatively raw because they are not yet categorized or quantified. Unlike narrative observations or on site coding, videos have not been filtered though the eyes of individual researchers, and are not as constrained by the initial hypotheses of those who design the study. For this reason they can be analyzed by researchers with different interests using different coding schemes" (p.197). Furthermore, Hollingsworth et all. (2003) discuss that using national video surveys to study teaching has additional advantages: "Video enables detailed examination of complex activities from different points of view. Video preserves classroom activity so it can be slowed down and viewed multiple times, by many people with different kinds of expertise, making possible detailed descriptions of many classroom lessons" (p.3). Masingila, Ochanji, and Pfister (2004) state "preservice teachers lack the experience necessary to observe meaningfully the complex and rapid interactions that can occur in a classroom. Experienced teachers are continuously making decisions regarding instruction and classroom interaction and appear to make these decisions with ease. Inexperienced preservice teachers often have difficulty recognizing what decisions were made and why, in order to ask questions about these decisions" (p.1).

Stigler and Hiebert (1999) emphatically point out that "Although most U.S. teachers report trying to improve their teaching with current reform recommendations in mind, the video show little evidence for change is occurring" (p.12). Romberg, Zarinnia and Collis (1990) "The crucial point is that the world is changing so rapidly that, unless those involved in mathematics education adopt a proactive view and develop a new assessment model for the twenty-first century, the mathematical understanding of children will continue to be inadequate into the future." (p.21)

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of the TIMSS video study was "to learn something about the way American teachers view reform and whether they are implementing teaching reforms in their classrooms" (Stigler & Hiebert, 1999, p.18)
Videos: TIMSS Video Study is a four-CD set that includes videos from eighth grade mathematics lessons in seven countries. There are 4 videotaped lessons from each country, total of 28 lessons.

From the following websites sample clips from the seven countries can be reached;

http://nces.ed.gov/pubs2003/timssvideo/3A.asp?nav=3

Each lesson has time linked index, text, resources and commentary. (see Figures, 1,2, and 3)

Figure1: Japanese Lesson-1

TIMSS Video Lesson Plan Observation & Analyses Protocol

Through the review of literature on observation and videotaped lesson analysis rubrics, author constructed TIMSS Video Lesson Plan Observation & Analyses Protocol. Observation techniques fall into two broad categories: structured or systematic observation and unstructured or ethnographic observation. (Clark & Leat,

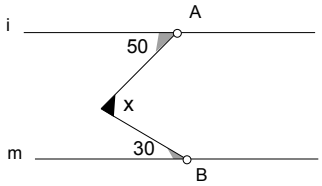
1998). Structured or systematic observation was developed by psychologist in the early 1920 and often used to generate data for statistical analysis of large populations.((Clark & Leat, 1998). This approach typically involves the observation of large samples of teachers and pupils by observers using coding scheme in which activities taking place at regular points in time or in particular time intervals (say every 3 seconds or every 25 seconds) are checked off.

The second category, unstructured or ethnographic observation, records as much of what happens as is possible. As a result, an ethnographic approach appeared to offer the best means of including more rather than fewer, behaviors, and of providing links between observed behaviors and the context. (Tilstone, C., 1998). For the purposes of this research students provided detailed guide called TIMSS Video Lesson Plan Observation & Analyses Protocol. First part of the guide focused on situational factors such as *the classroom climate* (This is the general tone and mood in the classroom. Climate is thought of as the convergence of factors such as nature of interaction, nature of the learning experience, degree of intellectual risk taking encouraged, mutual respect.), *the physical environment of the class* (number of students; arrangement of seating; clustering of students e.g., male, female; ethnic mix, etc.; "private" conversations among students; note taking.), *the style of the instruction*(lecture only; questions and kinds of responses; discussion. Along with the situational factors students were provided series (20) of specific questions (e.g. 6-How is the student engagement with the tasks? What is the extent of student involvement? Were all of the students engaged in the lesson? Cite the evidence. What does this evidence tell you about instruction? 10-Your appraisal of the overall success of the lesson, including supporting evidence. Include what you would do differently.)

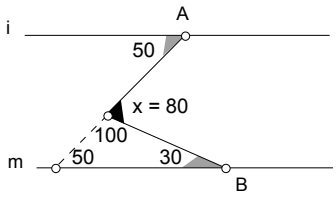
Japanese public release lesson-1: The lesson was on auxiliary lines. With this the classroom full of students is learning about geometric properties. From the extension activity the students took what they previously learned and began to understand the deeper complexities of more difficult problems. Following problem was an example from the class. Three students (Aria, Bunya, and Chika) came up with different solutions.

Figure 2: Japanese Lesson with Commentaries

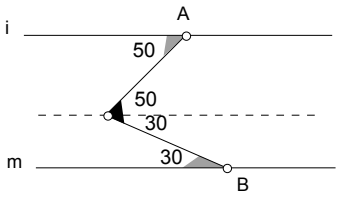
TIMSS Video Lesson Plan Observation & Analyses Protocol is provided before the references.



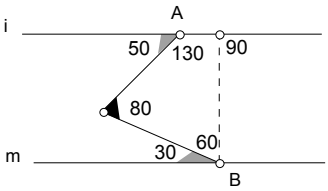
Find the angle in the bend with any method from the three problem solving methods (learned in yesterday's lesson).



Arai's method



Bunya's method



Chika's method

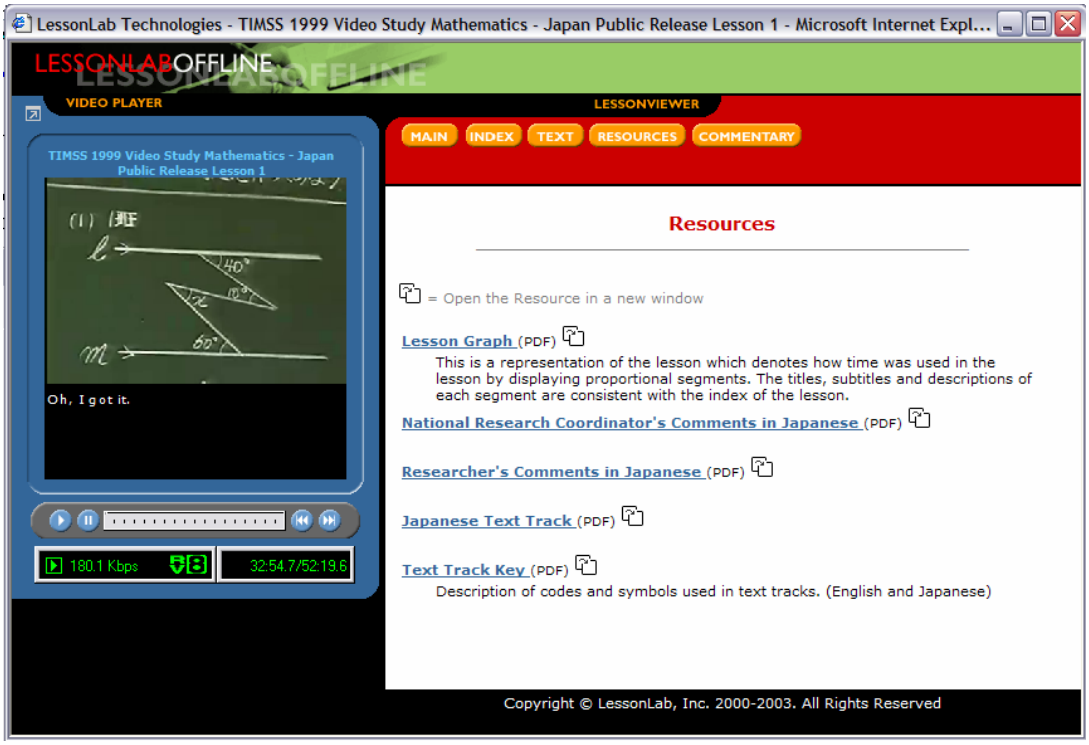


Figure 3: Japanese Lesson Resources

METHOD:

The twenty preservice mathematics teachers participated in this study was member of undergraduate problem solving class. Data were collected on 20 preservice middle and secondary mathematics teachers. All participants viewed Japanese lesson independently and wrote a reflection paper. Data were analyzed using qualitative data analyses(Marshall & Rossman,1999; Rossman & Rallis, 1998).Analyses of data was through analytical induction. Analytical induction is a strategy involving "scanning the data for categories, developing working typologies…" (Goetz & LeCompte, 1984, pp.179-180).

RESEARCH QUESTIONS:

1- To examine the prospective middle and secondary teachers' comparative analysis of TIMSS videotaped lesson (Japanese-1) from problem solving perspective.
2- To what extent preservice middle and secondary mathematics teachers discover new ideas about teaching?

3- To what extent preservice middle and secondary mathematics teachers make connections between learning theories and teaching in Japan.

HIGHLIGHTS FROM STUDENTS RESPONSES:

"Studying and analyzing videos of other cultures' teaching styles helps in gaining a better understanding of education across the globe, as opposed to simply reading about it."

The prospective teachers compared the Japanese lesson and their 8th grade classes and teaching. These are the points which were missing in their education as they compared to what is going on in Japanese class.

MISSING ELEMENTS:

Video data, such as collected in TIMSS, might help preservice mathematics teachers' to discover new ideas of teaching by recognizing the missing elements from their own education.

" I felt like the teacher was telling me what to do whole time and I was not given much of the opportunity to ask a lot of exploration questions."

"I do not remember being encouraged to seek and value alternative modes of investigation and problem solving- it was more like: here is the way dot his type of problem, now do 30 similar to it for homework."

"My teachers did not pose questions and provide activities; such as creating our own problems that we find challenging and perhaps that could have promoted more conceptual understanding of the material we were covering"

"In my high school mathematics classes if we came up with an answer our teacher told us right away that we were right or wrong. This may have hindered our ability to check our work, but if our teacher left the answers a mystery until the end, we may have made sure that we had the correct answer on our own"

"Most American classes I have been involve rote learning and procedural knowledge and not the conceptual knowledge that the students from Japan were receiving."

"In eight grade I was in Algebra-I and mathematics was simply cut and dry. The teacher told us exactly what to do it and how to do it and then we applied that exact method on the test or quiz or homework."

"It was always teacher's way or the problem was wrong"

" I am accustomed to in this country and their playfulness and lack of motivation"

"I do not remember having as much classroom discussion for activities like this. Much of my geometry instruction was done in the lecture fashion. I would have liked to have had instruction like this while taking geometry or other classes that taught geometry concepts and ideas."

"When the students were asked to do something, they did it without any complaints; something that I don't think ever happens in a classroom in the US."

"The Japanese classroom is just so different from the American classroom. I guess that I would have to say that we have less respect for our teachers and for learning than the Japanese."

"The students in the class all seemed to be fully engaged and on-task. You can see this just by looking at them. None of them are doodling on their papers, none of them are digging through their backpacks, none of them are passing notes to their neighbors; they are all looking up at the teacher and the board like they are hanging on to every word that he says. I think that it is amazing; the Japanese students just seem to have so much respect."

Stigler and Hiebert's(1999) primary analyses revealed that "…American mathematics teaching is extremely limited, focused for the most part on very narrow band of procedural skills. Whether students are in rows working individually or sitting in groups, whether they have access to the latest technology or are working only paper and pencil, they spend most of their time acquiring isolated skills through repeated practice." (pp.10-11)

MOTIVATION:

"The one thing caught my attention continuously through out the video was the lack of students that were off the task"

"Their motivation seems so much higher than of students in the American schools that I have observed"

"All of the students seemed interested in the lesson, and engaged in their task."

HIGHER ORDER THINKING AND THINKING OUTSIDE OF THE BOX:

"The students were constantly being challenged and encouraged to think outside of the box and apply ideas they have learned before the tasks."

"There is a high level of intellectual risk taking encouraged by the teacher toward the students. The in-class assignment gave the students the opportunity take what they had learned already and create extension problems. This level of problem solving pushes students beyond their plane of comfortable classroom activity, which usually promotes a deeper understanding of the ideas and material being taught in a class."

"I think that we can see students taking intellectual risks while they are drawing their own problems. The students really had to think creatively to draw these angles and they couldn't just draw crazy lines everywhere

because they had to be able to solve them. I think that the risk comes in because they all seemed to try and make them as hard as possible because they wanted to push the limits."

CREATIVITY:

Jakubowski, Corey, & Unal (2004) discuss that although mathematics and creativity goes hand to hand, unfortunately research on creativity in mathematics education scarce. As a result creativity in NCTM standards very limited.

"The teacher also posed questions that encouraged divergent thinking among the students- those kinds of questions are sometimes difficult to formulate"

"The questions teacher posed helped to trigger a divergent mode of thinking"

Analyses done by Stigler and Hiebert (1999) shows that "In Japan, teachers appear to take a less active role allowing their students to invent their own procedures for solving problems. And these problems are quite demanding, both procedurally and conceptually. NCTM (2000) "Well-chosen tasks can pique students' curiosity and draw them into mathematics ... Regardless of the context, worthwhile tasks should be intriguing, with a level of challenge that invites speculation and hard work. Such tasks often can be approached in more than one way…, which makes the tasks accessible to students with varied prior knowledge and experience. Worthwhile tasks alone are not sufficient for effective teaching. Teachers must also decide what aspects of a task to highlight, how to organize and orchestrate the work of the students ... and how to support students without ... eliminating the challenge"(pp.18-19). Jakubowski and Unal (2004) discuss elements of promoting creativity in mathematics as a teacher being more responsive and less directive with selected rich tasks.

INTERACTION AND GROUP WORKS:

"Going into groups though is a must and is very important for the students to learn from the other students in the classroom. The teacher can only do so much and be in so many places at the same time so groups really help the teacher if the students can answer each other's questions"

"I learned from watching this video the idea of switching from group work to individual work interchangeably. I don't remember ever doing that when I was in 8th grade"

"Critical moments in the students work seem to be when the students are working together to create more activities on their own. At this moment the students are accessing many benefits. For instance, since the students are working in groups they can learn from peer interaction. The students can brainstorm together, bounce ideas off of one another, and check each other's work."

"The active participation of the students was most definitely encouraged and valued, but maybe more required than encouraged. It was valued though because the teacher selected the problems that he liked the most and used them as class work and homework."

PEDAGOGY AND LEARNING THEORIES:

"The teacher worked diligently in supporting and enhancing students' investigation"

"Just from the discourse between the teacher and the students and the visual evidence of a typical classroom it would appear that strong relationships between the educator and those educated is highly valued."

The pedagogical content knowledge concept introduced by Shulman(1986) into teacher education community.

"I think it would have been neat to sit in on a Japanese classroom when I was taking a similar class."

"The Japanese teacher also provided students with plenty of wait time; students really had a lot of time to think and consider what they were learning which probably means that they are learning a lot more."

"The teacher definitely provided opportunity for interaction with the students and the opportunity for interaction among the students. Throughout the lesson the teacher walked around the room and spoke to many of the students and answered many questions"

"The teacher was working to support and enhance the students' investigation and this can be seen in the way he questions them. Instead of telling them the answers he kind of turned their question into a question for them; he answered questions with questions to encourage students to keep thinking for themselves."

CONCLUSIONS

Preservice teachers' comparisons what was going on in Japanese class and how it was when they were in 8th grade, showed that their education was not student centered. They didn't have a chance to explore ideas in depth. Their experiences revealed that solution of the given problem should be done "teachers' way". They exposed to rote learning and similar problem practice instead of conceptual understanding. Most of the preservice teachers mentioned that if they travel in time they wanted to sit in Japanese class and learn. This study shows that observation of teaching different cultures is a valuable activity.

ANALYSES PROTOCOL FOR TIMSS VIDEO LESSON

The purpose of TIMSS Videotape analyses activity was to getting familiar with a different classroom instruction in different cultures. Preservice teachers will have the opportunity to observe and learn from their counterparts in countries recognized for high student performance in mathematics. You are expected to keep careful notes during the observations. One of our discussions will be as a means of understanding the instruction from problem solving window.

Begin by situating your discussion through the following

1. Classroom climate: This is the general tone and mood in the classroom. Climate is thought of as the convergence of factors such as nature of interaction, nature of the learning experience, degree of intellectual risk taking encouraged, mutual respect
2. The physical environment of the class: number of students; arrangement of seating; clustering of students (e.g., male, female; ethnic mix, etc.); "private" conversations among students; note taking.
3. The "style" of the class: lecture only; questions and kinds of responses; discussion (who participated).
4. What is the subject matter, how it is presented, what is being learned (as compared with what is being taught), and what is your evidence?

In relation to these "situational" factors, go on to consider:

1. What the students were learning/understanding, and how do you know?
2. Compare your own previous experience in taking this class as you look back from here.
3. What are the problems as created by the students, at progressive phases in their work? Give examples.
4. What do you see as critical moments in the students' work?
5. Include a direct quote of one or two sentences made by a student that you found "important".
6. How is the student engagement with the tasks? What is the extent of student involvement? Were all of the students engaged in the lesson? Cite the evidence. What does this evidence tell you about Japanese instruction?
7. Include something you noticed or an event that you found surprising, and why.
8. What evidence is there that students took intellectual risks?
9. Did teacher provide opportunities for students to interact with him and with each other?
10. Your appraisal of the overall success of the lesson, including supporting evidence. Include what you would do differently.
11. Active participation of students was encouraged and valued
12. The teacher was working to support and enhance students' investigation
13. The teacher's questions triggered divergent mode of thinking
14. Students' comments and questions often determined the focus and direction of classroom discourse.
15. The lesson promoted strongly coherent conceptual understanding
16. This lesson encouraged students to seek and value alternative modes of investigation of problem solving
17. The lesson designed to engage students as members of a learning community

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