DOCUMENT RESUME

ED 301 421 SE 050 139

AUTHOR Lai, Morris K.; Whitman, Nancy C.
TITLE A Comparison of Mathematics Instruction in Tokyo and Hawaii Junior High Schools.
PUB DATE 88
NOTE 21p.; Paper presented at the Annual Meeting of the American Educational Research Association (Washington, DC, April 20-24, 1987).
PUB TYPE Reports - Descriptive (141) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Comparative Education; Cross Cultural Studies; Foundations of Education; *Junior High Schools; Mathematics Education; *Mathematics Instruction; *Mathematics Teachers; Secondary Education; *Secondary School Mathematics; *Teaching Methods
IDENTIFIERS Hawaii; Japan (Tokyo)

ABSTRACT

Using items from the Second International Study of Mathematics (1984) and the "effective teaching" literature, this study found differences between Tokyo and Hawaii junior high school teachers in terms of background, instructional behavior, teaching load, use of time, emphasis of objectives, and use of calculators. Hawaii teachers spent more time explaining homework. Classroom discipline was a greater concern for Hawaii teachers than for Tokyo teachers. Calculators were used much less in the Tokyo classes than in the Hawaii classes. Several other significant differences were found. It was noted that the instruments given to the Tokyo and Hawaii teachers were similar but several questions differed. Also, the comparisons were based on both public and private schools in Tokyo and only public schools in Hawaii. Finally, a random sampling of the Tokyo schools was used whereas all Hawaiian schools were invited to respond. (MVL)

A Comparison of Mathematics Instruction in Tokyo and Hawai'i Junior High Schools

Morris K. Lai
Nancy C. Whitman
University of Hawai'i

Paper presented at the annual meeting of the American Educational Research Association, Washington, D.C., 1987.

A Comparison of Mathematics Instruction in Tokyo and Hawai'i Junior High Schools

Abstract

Using items from the Second International Study of Mathematics and the "effective teaching" literature, this study found differences between Tokyo and Hawai'i junior high school teachers in background, instructional behavior, teaching load, use of time, emphasis of objectives, and use of calculators. Hawai'i teachers spent more time explaining homework. Classroom discipline was a greater concern for Hawai'i teachers than for Tokyo teachers. Calculators were used much less in the Tokyo classes than in the Hawai'i classes. Several other significant differences were found.

In the second International Mathematics Study (IEA, 1984), Japan's 13-year olds ranked first among 20 nations. The United States' ranking was near the median. To gain insights into this difference, we compared mathematics instruction as reported by teachers in Tokyo and Hawai'i junior high schools. Observations made in selected schools in Japan in 1983 and in Hawai'i schools over the past decade together with recent research on teaching effectiveness (e.g., Evertson, Emmer & Brophy (1980); Evertson et al. (1980); Good, Grouws, & Ebmeier (1983); and Smith (1977)) suggested variables worth investigating.

METHODOLOGY

Items from instruments developed by the Far West Laboratory for Educational Research and Development and by the International Association for the Evaluation of Educational Achievement (IEA) for the Second International Mathematics Study formed the core of the survey instrument. There were items on teacher background, teacher instructional behavior, teaching load, use of time, teachers' relative emphasis of mathematics instructional objectives, and use of calculators in the classroom.

The question format between the Hawai'i and Tokyo versions differed slightly. Some items that were multiple choice in the Hawai'i version were "open-ended" in the Tokyo version and vice versa on other items. On another item the choices of general school administrator and subject area administrator were combined into a single choice in the Tokyo version. Differences were the

result of negotiated compromises between the authors and Japan's National Institute for Educational Research.

Target Populations

The target population in Tokyo included junior high school teachers of mathematics in public and private schools. In Hawai'i the target population was public junior high school teachers of mathematics in the State of Hawai'i.

In 1983 there were 837 junior high schools in Tokyo. Of these, 77% were public, 22% were private, and 1% were ational (run by the Ministry of Education).

In 1984, there were 90 schools in Hawai'i that contained at least one of the grades: 7, 8, or 9. If a teacher taught at least one mathematics class in grades 7, 8, or 9, that teacher was considered for the purpose of this study to be a mathematics teacher.

Procedure

In Tokyo, 77 public schools and 23 private schools were randomly selected. Two questionnaires were sent to each school. Thirty-nine public and seven private schools returned the questionnaires. Both teachers from 21 of the schools and one of the two teachers from 25 of the schools returned questionnaires. Fifty-six questionnaires from public school teachers and eleven from private school teachers were completed.

In Hawai'i, all public junior high schools were invited to participate. Seventy-one questionnaires were returned.

Teacher Background

Table 1 presents the teacher background variables. Of the junior high school mat`ematics teachers in Tokyo 30% are female and 70% are male as compared to 62% female and 38% male in Hawai`i. The mean age of slightly under 40 for Tokyo teachers was very similar to that for Hawai`i teachers. Tokyo teachers, however, had a slight edge in years of teaching experience and in teaching mathematics.

The mean number of mathematics courses taken was similar for Tokyo teachers and for Hawai`i teachers; however, Tokyo teachers took more courses in the teaching of mathematics than did Hawai`i teachers.

Table 1 Tokyo and Hawai`i Teacher Background

	Tokyo			Hawai`i			
Variable	N	$\bar{X}$	SD	N	$\bar{X}$	SD	t
Sex: M	47	(70%)		27	(38%)		
F	20	(30%)		44	(62%)		
Age	67	39.6	11.7	70	39.9	8.4	0.2
Teaching Experience	67	15.2	12.2	70	14.3	8.3	-0.5
Math Teaching Experience	67	14.5	11.8	71	12.7	8.3	-1.1
# of Math Courses Taken	67	8.0	1.6	63	7.9	5.6	0.2
# of Math Methods Courses Taken	64	4.5	2.4	58	2.8	2.8	-3.6*
# of General Methods Courses Taken	66	4.5	2.5	51	4.7	4.3	0.3

* $p < .01$

Teaching Load

In Tokyo the average class period was 49.7 minutes versus 55.0 in Hawai'i. (See Table 2) There was substantially less variation in the length of class time in Tokyo than in Hawai'i classrooms.

Table 2 Number of Minutes in the Class Period in Tokyo and in Hawai'i

	Tokyo			Hawai'i			
	N	$\bar{X}$	SD	N	$\bar{X}$	SD	t
# of Minutes in Class Period	67	49.7	1.2	69	55.0	11.2	3.8*

* $p < .01$

As shown in Table 3 both Tokyo and Hawai'i teachers have about 19 hours per week of class contact periods. Seventeen of these are in teaching mathematics. However, in Hawai'i the variation among teachers is substantially greater than that in Tokyo.

Table 3 Class Contact Periods for Tokyo and Hawai'i Teachers

	Tokyo			Hawai'i			
Variables	N	$\bar{X}$	SD	N	$\bar{X}$	SD	t
Total Number of Class Contact Periods	67	19.2	3.3	70	19.4	9.6	0.1
Number of Mathematics Teaching Contact Periods	66	17.3	2.3	70	16.6	9.7	-0.5

As seen in Table 4 teachers in Tokyo and Hawai'i spent about two and a half hours per week preparing and planning for one mathematics class; however, in both places there was substantial teacher variation. Teachers in Tokyo spent almost two hours per week per class grading papers, quizzes and tests, in Hawai'i teachers reported they spent about twice as much time grading papers, quizzes, and tests as did the Tokyo teachers.

Hawai'i teachers tended to have students work individually and in subgroups more of the time than did Tokyo teachers. (See Table 5) The difference in amount of group work is statistically significant ($p < .01$). Hawai'i teachers spent more than three times the amount of time explaining new homework than did Tokyo teachers. Tokyo teachers spent about 8% more class time explaining or lecturing to the whole class than did Hawai'i teachers.

Table 4 Minutes Spent Per Week Per Class Outside of Class for Selected Class Activities by Tokyo and Hawai'i Teachers

	Tokyo			Hawai'i			
Activity	N	$\bar{X}$	SD	N	$\bar{X}$	SD	t
Grading papers, quizzes, & tests	64	110.9	103.3	68	232.0	184.7	4.60*
Preparing & planning for class (excluding the above activity)	63	149.2	199.6	67	143.3	123.6	-0.20

* $p < .01$

Table 5 Percent of Time in Class Spent on Various Activities by Tokyo and Hawai'i Teachers

	Tokyo			Hawai'i			
Activity	N	$\bar{X}$	SD	N	$\bar{X}$	SD	t
Checking homework	67	13.7	8.3	67	12.5	8.6	-0.8
Lecturing or explaining to the whole class	67	39.8	15.2	69	31.7	14.7	-3.2**
Having children work individually	67	30.6	13.1	68	35.7	16.9	2.0
Having children work in groups	67	2.2	4.7	52	5.7	10.1	2.5*
Explaining new homework	67	5.1	4.9	58	16.5	9.8	8.5**
Others	67	8.1	8.8	44	7.2	5.8	-0.6

* $p < .05$. ** $p < .01$

Hawai'i teachers expected 6 hours more homework per week than did Tokyo teachers. (See Table 6) In both teacher groups there was substantial individual variation. Our data on the amount of homework expected of Tokyo junior high school students is consistent with the research findings of Sawada and Kobayashi (1986) who attributed the relatively small amount of homework to the influence of the juku (after school) classes that about 50% of the students attend.

Table 6 Amount of Homework Time Per Week Expected of Students by Tokyo and Hawai'i Teachers

	Tokyo			Hawai'i			
	N	$\bar{X}$	SD	N	$\bar{X}$	SD	t
Homework Time Expected	67	1.7	1.1	69	7.7	16.4	3.03*

* $p < .01$

Also contributing to the Tokyo-Hawai'i difference was the different interpretation of the word "homework." Hawai'i students often did "homework" in class; however, the Japanese teachers regarded "homework" as literally work done at home.

Hawai'i teachers gave more emphasis to developing a systematic approach to solving problems; knowing mathematical facts, principles, and algorithms; and developing an awareness of the importance of mathematics in everyday life.

Tokyo teachers gave more emphasis to becoming interested in mathematics, understanding the nature of proof, developing an attitude of inquiry, and performing computations with speed and accuracy.

Table 7 Relative Emphasis Given by Tokyo and Hawai'i Teachers of Objectives in Teaching Mathematics

Objective	Tokyo N	Tokyo $\bar{X}$[a]	Tokyo SD	Hawai'i N	Hawai'i $\bar{X}$[a]	Hawai'i SD	t
Understand the logical structure of mathematics.	64	1.9	0.7	66	1.9	0.7	0.0
Understand the nature of proof.	63	1.7	0.7	66	2.6	0.6	-8.4**
Become interested in mathematics.	64	1.7	0.7	65	1.9	0.6	-1.9
Know mathematics facts, principles, and algorithms.	62	2.0	0.6	66	1.4	0.5	6.8**
Develop an attitude of inquiry.	63	1.7	0.6	66	1.9	0.7	-1.6
Develop an awareness of the importance of mathematics in everyday life.	64	2.1	0.7	65	1.6	0.7	4.0**
Perform computations with speed and accuracy.	62	1.7	0.7	66	1.8	0.6	-0.9
Develop an awareness of the importance of mathematics in the basic & applied sciences.	63	2.4	0.7	66	2.0	0.7	3.2**
Develop a systematic approach to solving problems.	63	1.7	0.6	66	1.4	0.6	2.8**

a 1: Relatively more emphasis, 2: About equal emphasis, 3: Relatively less emphasis.
** $p < .01$

In Table 8 are listed those classroom behaviors for which there is a statistically significant difference in means ($p < .05$ or $p < .01$) between Tokyo and Hawai'i teachers. As seen in Table 8 Tokyo teachers presented more instruction and/or information by outlining the lesson before proceeding. On the other hand Hawai'i teachers spent more time explaining concepts, definitions, relationship of tasks to goals, illustrating how to do the work, how to do a problem, and answering students' questions about what they were to do. Tokyo teachers more than Hawai'i teachers established and maintained the engagement of students in instruction, tasks, and activities by telling students to attend to tasks (whole class or individually). Hawai'i teachers more often signaled students to get to work (turning off lights, eye contact, etc.) and encouraged students to keep up (maintain pace). Tokyo teachers more than Hawai'i teachers monitored students' progress in learning and completing tasks by scanning the room, by monitoring students' responses, and by roaming the room checking students' work. Hawai'i teachers on the other hand more often reviewed students' work when completed, questioned students on whether they completed work, learned a concept or learned a fact, and collected students' work.

Table 8 Significant Mean Differences Between Tokyo and Hawai'i Teachers' Classroom Behavior

Item	Tokyo N	Tokyo $\bar{X}$[a]	Tokyo SD	Hawai'i N	Hawai'i $\bar{X}$[a]	Hawai'i SD	t
Outline the lesson before proceeding.	67	2.0	0.9	71	3.0	1.0	5.8**
Explain concepts, definitions, relationships of task to goals, etc.	67	2.2	0.7	71	1.6	0.7	-4.8**
Illustrate how to do the work, how to do the problem, etc.	66	1.6	0.6	71	1.2	0.4	-4.3**
Answer students' questions about about what they are to do.	67	1.5	0.7	71	1.3	0.5	-2.1*
Tell students to attend to tasks (whole class or individually).	67	1.6	0.8	70	2.0	0.8	2.7**
Signal students to get to work (turn off lights, eye contact, etc).	65	4.6	1.1	71	2.1	0.9	-14.5**
Encourage students to keep up (maintain pace).	66	2.2	0.9	71	1.9	0.7	-2.2*
Scan the room to see if everyone is working.	67	1.2	0.4	71	1.6	0.6	5.0**
Review students' work when it is completed.	65	3.1	1.0	71	1.6	0.6	-10.5**
Monitor students' responses.	67	1.3	0.6	70	1.8	0.7	4.7**
Roam the room checking students' work.	67	1.4	0.6	71	2.0	0.7	5.4**
Question students: learned a concept, learned a fact, completed work.	67	2.3	1.0	70	2.0	0.7	-2.0*
Collect students' work.	67	2.5	0.8	71	1.4	0.7	-8.7**

* $p < .05$. ** $p < .01$

[a] 1: Always 2: Frequently 3: Sometimes 4: Occasionally 5: Never

When asked for what proportion of students in a typical class they monitored progress in learning and completing tasks and for what percent of students they provided instructional feedback, Hawai'i teachers gave much higher percentages than did Tokyo teachers. (See Table 9)

Table 9 The Percent of Students for Whom Progress in Learning and Completing Tasks are Monitored and Instructional Feedback Provided in a Typical Class by Tokyo and Hawai'i Teachers

	Tokyo			Hawai'i			
	N	$\bar{X}$	SD	N	$\bar{X}$	SD	t
Progress in learning & completing tasks monitored	63	37.5	29.8	68	84.2	22.6	10.1*
Instructional feedback provided	63	24.0	20.6	68	82.0	24.0	14.7*

* $p < .01$

The Calculator

When asked: "In your school in which subject(s) is the use of calculators encouraged? Check one," mathematics teachers in Tokyo and Hawai'i responded as shown in Table 10.

Table 10 Extent to Which the Use of Calculators is Encouraged

Subjects	Tokyo n=67 % of teachers	Hawai'i n=71 % of teachers
None	74.6%	32.8%
Mathematics only	11.9%	18.3%
Science only	3.0%	1.4%
Mathematics and science	4.5%	14.1%
All or most subjects where appropriate	3.0%	22.5%
No response	3.0%	11.3%

A far greater percent of Tokyo teachers as compared to Hawai'i teachers reported that in no subject is the use of calculators encouraged. A greater percent of Hawai'i teachers reported encouragement of the use of calculators in subjects where appropriate.

When asked to select a description that best described their departments' policy on the use by students of 'four function' and of pre-programmed multifunction and/or programmable calculators in the classroom, teachers' responses in Tokyo and Hawai'i were as shown in Table 11.

Table 11 Policy Related to Use of Calculators in Tokyo and Hawai'i Classes

Description	Tokyo A* calculator	Tokyo B* calculator	Hawai'i A calculator	Hawai'i B calculator
No policy formulated.	35.8%	32.8%	60.6%	64.8%
Students forbidden to use calculators in class.	29.9%	23.9%	4.2%	1.4%
Students may use calculators but they are not provided by schools.	7.5%	16.4%	9.9%	4.2%
Calculators provided by schools but rarely used in class.	13.4%	7.5%	12.7%	1.4%
Calculators provided by schools and frequently used in class.	1.5%	1.5%	2.8%	1.4%
Question does not arise.	10.4%	14.9%	5.6%	19.7%
No response	1.5%	3.0%	4.2%	7.0%

* A = four function, B = preprogrammed multifunction and/or programmable

Both in Tokyo and Hawai'i a substantial percent of the teachers indicated that no policy on calculator usage by students in their schools had been formulated. In Tokyo when a policy had been formulated, it forbade the use of calculators in classrooms.

PART IV SUMMARY/DISCUSSION

There were substantial differences between Hawai'i and Tokyo junior high school mathematics teachers. In Hawai'i the percent

of female teachers was about twice that in Tokyo. Teachers in Hawai'i took fewer mathematics methods courses. The teaching load in terms of contact periods was the same for both groups; however, the class periods were shorter in Tokyo. In addition, the number of school days in Tokyo (243 days in the IEA Study) was greater than in Hawai'i (174 days). A larger percentage of Hawai'i teachers taught other subjects in addition to mathematics compared to Tokyo teachers. Seldom were junior high school mathematics teachers in Tokyo not mathematics majors.

In Hawai'i teachers spent twice the amount of time Tokyo teachers did in grading papers, quizzes, and tests. The impact of this effort at grading papers on student achievement and attitude is worth studying. Hawai'i teachers also spent more time than Tokyo teachers in explaining new homework. On the other hand, Tokyo teachers spent more time lecturing to the whole class. It is possible that Hawai'i teachers found themselves spending the amount of time explaining new homework because the skills, concepts, and generalizations needed to do the homework were not sufficiently developed prior to making the homework assignment.

Both Tokyo and Hawai'i teachers when identifying effective teaching techniques emphasized factors such as 1) thinking about how to clear up instructional problems which have arisen in the course of a previous lesson, 2) making sure that students know exactly what they should be doing, and 3) identifying students who are in difficulty but do not ask for assistance.

Hawai'i teachers more than Tokyo teachers emphasized the need to anticipate and forestall student disturbances before they occur. This suggests that in Tokyo there was less need to be concerned about classroom discipline problems than in Hawai'i or the United States.

Hawai'i teachers more than Tokyo teachers emphasized a more structured classroom. Instead of emphasizing establishing and enforcing clear-cut rules for students' behavior, Tokyo teachers appeared to emphasize the presentation of their subject matter.

Hawai'i teachers more than Tokyo teachers emphasized the need for individual differences in the classroom. Tokyo teachers may find providing for individual differences by differential assignments contrary to their concept and goal of providing equal educational opportunity for all students. In many school competitions in Japan, awards are made to groups, not to individuals.

Tokyo teachers compared to Hawai'i teachers gave more emphasis to having students become interested in mathematics, understand the nature of proof, develop an attitude of inquiry, and perform computations with speed and accuracy, whereas Hawai'i teachers gave more emphasis to developing a systematic approach to solving problems, knowing mathematical facts, principles, and algorithms, and developing an awareness of the importance of mathematics in everyday life.

In addition, Hawai'i teachers compared to Tokyo teachers monitor students' progress in learning and provide instructional

feedback a much greater percentage of the time. This may in part account for the relatively large amount of time Hawai'i teachers spend in grading papers.

The calculator is not widely used in Tokyo or Hawai'i classrooms. This is in spite of the fact that in Japan the Ministry of Education is encouraging the use of calculators in mathematics classroom through its Course of Study and through financial support to schools for equipment*, and in Hawai'i the State Mathematics Program Guide (HDOE, 1979) and the recommendations of the National Council of Teachers of Mathematics (NCTM, 1980) both encourage school mathematics programs to take full advantage of the power of calculators. One of the reasons why the calculator is not widely used in Tokyo is that school policy might forbid its classroom use. However, when calculators are provided by the school, they are still not frequently used. Perhaps teachers tend to emphasize the understanding of mathematical concepts and regard applications only as examples for illustrating those concepts.

In summary, Hawai'i and Tokyo teachers emphasized different classroom behavior and were notably different in many other ways. Whether any of these differences are causally related to the

---

* Information provided by N.I.E.R.

** Suggested by Professor Shigeru Shimada in "Mathematics Education Information Report --- International Calculator Review ---" by ERIC/SMEAC, March 1980

differences in student achievements is not yet known; however, this study has revealed some prime candidates for further (causal) studies.

REFERENCES

Evertson, C. M., Anderson, C. W., Anderson, L. M., & Brophy, J. E. (1980). Relationships between classroom behaviors and student outcomes in junior high mathematics and English classes. American Educational Research Journal, 17(1), 43-60.

Evertson, C. M., Emmer E. T., & Brophy, J. E. (1980). Predictions of effective teaching in junior high mathematics classrooms. Journal for Research in Mathematics Education, 11, 167-178.

Good, T. H., Grouws, D. A., & Ebmeier, H. (1983). Active Mathematics Teaching. Research on Teaching Monograph Series. New York: Longman.

Hawai'i Department of Education, General Education Branch. (1979). Mathematics program guide. Honolulu: Author.

International Association for the Evaluation of Educational Achievement. (1984, September). Second International Mathematics Study. Summary Report for the United States.

National Council of Teachers of Mathematics (NCTM). (1980). An agenda for action: Recommendations for school mathematics of the 1980's. Reston, VA: Author.

National Council of Teachers of Mathematics (NCTM). (1984, September). Halftime for the agenda: Progress and concerns. News Bulletin.

Sawada, T. (1986, July). Comparisons of achievement in problem solving on SIMS between the United States and Japan. Paper presented at the U.S. - Japan seminar on mathematical problem solving, Honolulu.

Sawada, T., & Kobayashi, S. (1986, March). An analysis of the effect of arithmetic and mathematics education at Juku. Tokyo: National Institute for Educational Research.

Smith, L. R. (1977). Aspects of teacher discourse and student achievement in mathematics. Journal for Research in Mathematics Education, 8, 195-204.