Public Good or Private Commodity?

Mathematics Education in Japan and Implications for the U.S.

Linda H.L. Furuto
University of Hawai'i
Pearl City, HI
lfuruto@hawaii.edu

Abstract

Given the flow of global policy and educational reform, a number of countries are approaching junctures on issues of equal access and opportunity. This study begins with the major role supplemental mathematics education plays in Japan. Research was conducted as a visiting scholar at the University of Tōkyō, and supported by classroom experience. The contextual background then leads to a discussion on sector relationships in the U.S., where a culture has emerged of relying on privatized education such as academic tutoring and test preparation. Although educators in both countries question the impact of growing sector disparities, the reality is that they have just begun to address issues of equity and accessibility to ensure education is provided as a public good.

Keywords: Mathematics achievement, cultural diversity, and equity.

Introduction

Educational Equity

Given the flow of global policy and educational reform, a number of countries are approaching significant educational junctures on issues of equal access and opportunity. According to the National Council of Teachers of Mathematics (2008), further research is needed to prepare the next generation of scholars because "ensuring America's stature as the world's leader hinges on our ability to educate *all* students as we move into an era with increased technical demands" (p. 2). In order to examine the U.S. case, a cross-national comparison of mathematics education as a public good versus private commodity with Japan will be presented.

Theoretically, Japan provides a system of education open to all citizens. However, there

Journal of Mathematics and Culture
November 2010 5 (2)
ISSN – 1558 - 5336

is a growing tendency for the wealthy to opt for private schools and supplemental education that provide children greater opportunity to pass national examinations and eventually entrance to one of the prestigious universities. Rather than measuring the abilities of students in more than one endeavor, the Japanese system bases most of the selection process on a test score. *Juku* and supplemental education in Japan supply not only educational choice but a form of competition to the public school system as well (Russell, 2002). *Juku* are defined as special types of private cram schools that offer academic lessons conducted after regular school hours and on the weekends. These cram schools prepare students for higher levels of education, as well as rigorous national examinations (Russell, 2002).

According to recent Japanese government surveys, nearly 70% of students enroll in the private sector by the time they leave the ninth grade. The largest *juku* companies are traded on stock exchanges, and the industry generates 1.4 trillion yen (approximately $12 billion) in revenue annually (Yano Research Institute, 1994; LeTendre, 2001; DeCoker, 2002). Some 6.5 million children are estimated to attend *juku* in Japan, which has become an important consumer commodity for wealthier families. The growing acceptance of market-driven approaches in education continues to strengthen this trend.

This research comes at an opportune moment for Japanese and U.S. educators, policymakers, and researchers. Equity-based reform has consumed discussions of academic achievement in both societies, especially given that U.S. schoolchildren continue to lag behind international standards. The 2003 Third International Mathematics Science Study (TIMSS) resulted from the need for reliable and timely data on the mathematics and science achievement

Journal of Mathematics and Culture
November 2010 5 (2)
ISSN – 1558 - 5336

of U.S. students compared to that of students in other countries. TIMSS is the most comprehensive and rigorous assessment of its kind ever undertaken with a total of 41 participating countries. TIMSS director James Stigler concluded that instructional practices and expectations of all children regardless of cognitive factors is one of the leading variables in increasing academic achievement. (National Center for Education Statistics, 2003).

Even though almost every state in the U.S. is working to develop higher standards for what students should be learning, along with the means for assessing their progress, the quick-fix solutions implemented so far have not had a noticeable impact. In light of this, the U.S. has developed an emergent culture of relying on privatized education. A booming industry offers online diagnostic tests, private academic tutoring, SAT prep courses, and personalized guidance on how to navigate the college-application process. National Council of Teachers of Mathematics literature asserts that although the number of U.S. studies has grown in recent years due to changes in policies and priorities at federal agencies, these studies are only beginning to yield findings on privatized education and their number remains comparatively small (NCTM, 2008).

In this study, I begin with an introduction to the Japanese test preparation culture, followed by an in-depth presentation of supplemental education with qualitative and quantitative data. Research was conducted over several years as a visiting scholar at the University of Tōkyō, and complemented with hands-on experience at four public and private schools. I will focus on West Cram School, which is one of the largest providers of supplemental education in the country thus yielding valuable information. Data analysis raises issues of educational equity and

Journal of Mathematics and Culture
November 2010 5 (2)
ISSN – 1558 - 5336

the impact of sectors on the Japanese system. The contextual background leads to a discussion on implications for public and private relationships in the U.S., and the future of access to education. This research is a cooperative project, supported by the University of Tōkyō, Waseda University, Ōbirin University, University of California, Los Angeles, and the Japanese Ministry of Education, Culture, Sports, Science, and Technology (MEXT).

Supplemental Education

Japan supports a wide-range of academic institutions outside of the public school system. This dense network consists of home tutors, correspondence courses, *juku,* and examination preparation schools (*yobiko*), among others. These forms of extra schooling have been described as "shadow education" because their private sector curriculum tends to shadow and enhance the curriculum offered in the public schools (Rohlen, 1983; Stevenson & Baker, 1992).

There are two major types of *juku*, individual enrichment courses and academic *juku*. The academic *juku* are further divided into review *juku* which cater to students who need remedial assistance, and advancement *juku* which cater to students preparing for the entrance examinations. Review *juku* are popular with upper-elementary and junior high school students. Students in the latter *juku* receive basic help in subjects that they find difficult. Many of these *juku* are run out of private homes by teachers who use the same texts used in the classroom. The advancement *juku* are the ones that most closely match Western stereotypes. These schools are largely attended by junior high and high school students seeking to prepare for the upcoming entrance examinations. Moreover, there are schools that specifically prepare students for the college entrance examination (Stevenson & Baker, 1992; Tsukada, 1991). Students who fail to

Journal of Mathematics and Culture
November 2010 5 (2)
ISSN – 1558 - 5336

get into the college of their choice may spend a year or two studying at *yobiko* after graduating from high school. This is not uncommon since attendance at an esteemed university may be a life-altering course.

Individual enrichment courses, primarily non-academic in nature, are most popular among elementary and nursery school students. These *juku* teach activities such as swimming, piano, arts and crafts, dance, and calligraphy. Some Japanese consider them to be distinct from the academic *juku* because of the lack of rigor and discipline.

In a survey of over 60,000 students conducted by the Ministry of Education, Culture, Sports, Science, and Technology (MEXT, 2006), the percentage of students attending *juku* was documented over a twenty-year period. Enrollment in individual enrichment courses tended to decrease over time while enrollment in advancement courses increased. Enrollment also varied markedly according to the size and location of cities, with a much higher participation rate of students in large, metropolitan areas such as Tōkyō. Figure 1 shows the trends of percentage of students enrolled in *juku* by grade level.

Journal of Mathematics and Culture
November 2010 5 (2)
ISSN – 1558 - 5336

Figure 1. Percentage of students enrolled in *juku* by grade level.

Grade Level	Advancement *juku*		Enrichment *juku*	
	1985	2005	1985	2005
Elementary				
1	6.2%	12.1%	60.1%	70.1%
2	10.1	14.1	69.1	79.4
3	12.9	17.5	76.8	81.2
4	15.4	23.6	78.0	82.5
5	21.1	31.1	73.9	77.5
6	29.6	41.7	65.7	70.6
Junior High				
1	41.8	52.5	35.7	36.7
2	44.5	59.1	26.4	29.3
3	47.3	67.1	19.6	18.8

SOURCE: MEXT, 2006, p. 9.

Impact on the Japanese Educational System

In a 1994 MEXT survey, students said the second most important benefit of attending *juku* was that they could "go beyond public school lessons" (p. 76). If students can surpass the standards, classroom study becomes a place of academic review. Academic *juku*, such as West School, provide lessons not offered by public schools. For example, some parents enroll their elementary school age children to study English, which doesn't become compulsory in public schools until later years. When *juku* accelerates students to the extent that school becomes a place for review, *juku* begin to impeded on public education, and the state system is no longer a place of educational equity.

As long as entrance examinations are key to academic and future career success, and *juku* can help students improve their scores, private educational services will continue to be in

Journal of Mathematics and Culture
November 2010 5 (2)
ISSN – 1558 - 5336

demand. They emphasize the tenuous authority of national standards when unofficial standards, such as a high-stakes entrance examination, set the learning bar higher.

The growing presence of private educational services in Japan may be seen in the trend toward private schooling in Japan since the mid-1990s. The most sought after schools combine the junior high and high school years into a combined six-year program, enabling students to attend the same school uninterrupted by an entrance exam that normally is taken at the end of Japanese junior high school. Such private schools claim that, in the absence of the test, they are freer to offer augmented curricular and cultural activities (i.e., food festivals, sports tournaments, and New Year's traditional events) and respond more sensitively to individual needs. Such schools also have a track record of placing their graduates in competitive universities. Amano (1996) demonstrates that the composition of students who gain admission to the most selective university in Japan has changed dramatically over the course of 25 years from predominantly public school graduates to predominantly private school students. Moreover, "of the top 20 high schools in the country that sent students to the nation's most prestigious University of Tōkyō in 1964, five were private schools. By 1979, the private school figure had grown to 11, and by 1989, 25 years later, 75% of the schools sending graduates to the University of Tōkyō were private and only five were public" (Amano, 1996, pp. 279-280). Based on Amano's data, if one accepts the premise that attending a test-focused *juku* is a requirement for successful admission to a private high school or selective university, it seems clear that studying at *juku* is an integral component of educational success in Japan (Amano, 1996).

Methodology

Journal of Mathematics and Culture
November 2010 5 (2)
ISSN – 1558 - 5336

Research was conducted at North Elementary School, South Elementary School, East Elementary School, and West Cram School, with permission to use data granted by the respective schools and districts. The upper-elementary students and schools were selected because of the turning point in educational paradigms that occurs during the schooling and early-youth development of preadolescents (10-12 year olds). In upper-elementary school, students experience dramatic shifts in the type of instruction received, become aware of the expectations adults have for them, and undergo psychological and physiological changes. Japanese students are also subjected to powerful social pressures from peers and the media that mirror wider concerns in Japanese society. The complexity of these educational concerns, such as the tension between the ideal of learning as an exploration and learning as examination preparation, at this juncture makes change difficult. Thus, the experiences of Japanese students provide critical information on education as a public good versus a private commodity.

Survey analysis was the first methodological strategy employed to answer the underlying research question, what factors of public and private education affect mathematics achievement as observed in upper-level Japanese elementary schools? The quantitative survey took approximately 30 minutes to complete, and was based on the work of Helen Astin (2000), Alexander Astin (1987, 2000), Astin, Green and Korn (1987), and Derek Bok (1996) at the UCLA Cooperative Institutional Research Program. The UCLA Cooperative Institutional Research Program is an interdisciplinary center for research, evaluation, information, policy studies, and research training in education. I incorporated this body of knowledge into my survey because of the tools and resources they provided to conduct research at the institutional

Journal of Mathematics and Culture
November 2010 5 (2)
ISSN – 1558 - 5336

level, and the partnerships they developed with educational organizations based on longitudinal data.

My survey included demographic, attitudinal, family/community-related, and future-oriented objective questions. Data analysis of ordered logistic regression focused on the logit and probit versions of the ordered regression model, in terms of an underlying latent variable, selected to fit the types of data and variables under consideration. Figure 2 below provides a description of major variables and measurements.

Figure 2. Description of major variables and measurements.

Variable Name	Description	Measurement
q00	School	1 = North Elementary 2 = South Elementary 3 = East Elementary 4 = West Cram School
q01	Grade Level	1 = Fifth Grade 2 = Sixth Grade 3 = Other
q02	Gender	1 = Male 2 = Female
q03	Age	1 = < 9 Years 2 = 9 Years 3 = 10 Years 4 = 11 Years 5 = 12 Years 6 = > 12 Years
q04	Anticipated Highest Academic Degree	1 = Junior College 2 = University 3 = Graduate/Professional School 4 = Other
q05	School-related Experiences	1 = Frequently 2 = Occasionally 3 = Never

Journal of Mathematics and Culture
November 2010 5 (2)
ISSN – 1558 - 5336

q06	Future Occupation	1-18 = Various Occupations 19 = Other 20 = Haven't Decided
q07	Hours Spent Doing Weekly Activities	1 = None 2 = 1-2 Hours 3 = 3-5 Hours 4 = 6-10 Hours 5 = 11-15 Hours 6 = 16-20 Hours 7 = 20+ Hours
q08	Personal Importance of Values/Goals	1 = Essential 2 = Somewhat Important 3 = Not Important
q09	Items Possessed by Respondent	1-12 = Various Items
q10	Rating of Respondent's Characteristics/Traits	1 = Upper 10% 2 = Above Average 3 = Average 4 = Below Average 5 = Lower 10%
q11	Elementary School Mathematics Grades	1= High 2 = Upper Middle 3 = Middle 4 = Lower Middle 5 = Lower 6 = Don't Know, Can't Remember
q12	Teacher Expectations and Views	1 = Frequently 2 = Occasionally 3 = Never
q13	Number of Years Attending *Juku*	1 = < 1 Year 2 = 1 Year 3 = 2-3 Years 4 = 4-5 Years 5 = 6-7 Years 6 = > 7 Years
q14	Grade Level Began Attending *Juku*	1 = First Grade 2 = Second Grade 3 = Third Grade 4 = Fourth Grade 5 = Fifth Grade 6 = Sixth Grade

Journal of Mathematics and Culture
November 2010 5 (2)
ISSN – 1558 - 5336

Features of Japanese schooling were investigated secondarily with qualitative techniques. The focus groups were semi-structured, open-ended interviews, involving 4-5 participants. They were complementary to quantitative methods, providing further understanding of the organizational history and structure of schools, curriculum and instruction, assessment and evaluation, and their influences on mathematics achievement (Fetterman, 1998; Bickman, 1993, 1998; Rog, 1998). Some of the focus group questions included "What role do public and private school teachers play in the lives of students?" and "Is there a noticeable difference mathematics achievement between students who attend *juku* and those who don't?" Focus group interviews were conducted with 25 fifth and sixth grade students and 25 teachers/administrators at the four research sites, for a total of five student focus groups and five teacher/administrator focus groups.

Major Findings

Descriptive Analysis

Descriptive analysis illustrates general characteristics of the sample population of 278 fifth and sixth grade students at four schools. There was no missing data for any of the variables in the analyses. Figure 3 is a contingency table of grade level (q01) by school (q00). The chi-square test is not statistically significant, indicating there is no association between grade level and school attended. There is a fairly even representation of fifth and sixth graders across all four schools. Overall, 52.52% of the population is in the fifth grade (146 students) and 47.48% is in the sixth grade (132 students). North Elementary is coded as school 1, South Elementary is school 2, East Elementary is school 3, and West Cram School is school 4. 24.82% of the sample

Journal of Mathematics and Culture
November 2010 5 (2)
ISSN – 1558 - 5336

is from North Elementary School (69 students), 30.58% is from South Elementary School (85 students), 28.42% is from East Elementary School (79 students), and 16.19% is from West Cram School (45 students).

Figure 3. Contingency table of grade level (q01) by school (q00).

grade level	school 1	2	3	4	Total
grade 5	38	42	42	24	146
	55.07	49.41	53.16	53.33	52.52
grade 6	31	43	37	21	132
	44.93	50.59	46.84	46.67	47.48
Total	69	85	79	45	278
	100.00	100.00	100.00	100.00	100.00

Pearson chi2(3) = 0.5347 Pr = 0.911

Contingency tables of gender by school and age by school indicate that gender and age composition are relatively homogeneous across schools. Approximately half of the population sample is male (48.56%, 135 students), and the other half is female (51.44%, 143 students). Interestingly, there is a noticeable difference between male and female numbers at West Cram School, where 57.78% of the students are male and 42.22% are female. The majority of students are 11-12 years of age (97.84%), with a few 10 and 13 year olds. The ages are generally similarly distributed across schools. There tend to be slightly more 11 year olds (53.60%, 149 students) than 12 year olds (44.24%, 123 students).

The intraclass correlation of mathematics achievement (acadachvt) by school (q00) also provides useful information. Based on review of the literature and the UCLA Cooperative Institutional Research Program, the intraclass correlation (0.56) is substantial and shows that

Journal of Mathematics and Culture
November 2010 5 (2)
ISSN – 1558 - 5336

schools are significantly different across populations and fairly homogeneous within, as expected (Aldrich & Nelson, 1984; Astin & Astin, 2000; Bickman, Hedrick, & Rog, 1993; Bok, 1996). Figure 4 provides a contingency table of cross-tabulation and chi-square of mathematics achievement (acadachvt) by school (q00) that support intraclass correlation findings. The chi-square test is statistically significant at the 0.001 α-level (p = 0.000), indicating there is a strong association between mathematics achievement and school attended.

Figure 4. Contingency table of mathematics achievement (acadachvt) by school (q00).

acadachvt	school 1	2	3	4	Total
1	3	3	35	0	41
	4.62	3.90	52.24	0.00	16.27
2	19	55	29	3	106
	29.23	71.43	43.28	6.98	42.06
3	43	19	3	40	105
	66.15	24.68	4.48	93.02	41.67
Total	65	77	67	43	252
	100.00	100.00	100.00	100.00	100.00

Pearson chi2(6) = 168.0325 Pr = 0.000

Juku Data Analysis

The trends of students attending *juku* by school are revealing about the types of students that have access to supplemental education. Figure 5 is a cross-tabulation and chi-square of the number of years attended *juku* (q13) by school (q00). In each cell within the table, the top number is the frequency, the second number is the row percentage, and the third number is the column percentage. The Pearson chi-square value is given at the bottom, along with the significance probability. The chi-square test is significant at the $p < 0.001$ level, indicating that

Journal of Mathematics and Culture
November 2010 5 (2)
ISSN – 1558 - 5336

there is a relationship between schools (1 = North Elementary School, 2 = South Elementary School, 3 = East Elementary School, 4 = West Cram School) and the number of years students attend *juku*.

Figure 5. Cross-tabulation and chi-square of *juku* attendance (q13) by school (q00).

years *juku*	school 1	2	3	4	Total
0-1 yrs	51	66	68	20	205
	24.88	32.20	33.17	9.76	100.00
	73.91	77.65	86.08	44.44	73.74
2-5 yrs	17	18	11	19	65
	26.15	27.69	16.92	29.23	100.00
	24.64	21.18	13.92	42.22	23.38
6-7 yrs	1	1	0	6	8
	12.50	12.50	0.00	75.00	100.00
	1.45	1.18	0.00	13.33	2.88
Total	69	85	79	45	278
	24.82	30.58	28.42	16.19	100.00
	100.00	100.00	100.00	100.00	100.00

Pearson chi2(6) = 37.8335 Pr = 0.000

The number of years attended *juku* is divided into three categories (0-1 years, 2-5 years, and 6-7 years). Attending *juku* for 2-5 years at the elementary school level is a good indicator of time, resources, and financial investment of parents in their children. Most of the students in this category began attending *juku* when they were in the first or second grade. 26.15% of students at North Elementary School, 21.18% of students at South Elementary School, 13.92% of students at East Elementary School, and 42.22% of students at West Cram School attended *juku* 2-5 years.

In Figures 6 and 7, mathematics achievement (acadachvt) is the outcome variable and

Journal of Mathematics and Culture
November 2010 5 (2)
ISSN – 1558 - 5336

number of years attended *juku* (q13) is the predictor variable. Mathematics achievement is based on three point categories from 1 point (low) – 3 points (high) that reflect the elementary school mathematics grades of the student measured in the quantitative survey. The number of years attended *juku* (q13) proves a statistically significant predictor of mathematics achievement at the 0.05 α-level (p = 0.049). A one point change in the number of years attended *juku* is associated with a 0.94 increase in the logistical odds of being in a higher category of mathematics achievement. Thus, a one point change in number of years attended *juku* results in a significant difference on the outcome of mathematics achievement.

Figure 6. Ordered logistic regression of *juku* attendance (q13) and mathematics achievement (acadachvt).

```
Ordered logistic regression                     Number of obs   =        252
                                                Wald chi2(1)    =       3.87
                                                Prob > chi2     =     0.0490
Log pseudolikelihood = -250.81947               Pseudo R2       =     0.0285

                              (Std. Err. adjusted for 4 clusters in q00)
------------------------------------------------------------------------------
             |               Robust
  acadachvt |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
 years juku  |   .9392696   .4771544     1.97   0.049    .0040643    1.874475
-------------+----------------------------------------------------------------
       /cut1 |  -.5067169   .8429937                     -2.158954     1.14552
       /cut2 |   1.54194    .4376586                      .6841453    2.399736
------------------------------------------------------------------------------
```

The odds ratio provides information to determine the effect of mathematics instruction on mathematics achievement. A student's ability to move to the next higher category of mathematics achievement is 2.558, with a one point increase in number of years attended *juku*. Recall, mathematics achievement is a three point system reflecting elementary school

Journal of Mathematics and Culture
November 2010 5 (2)
ISSN – 1558 - 5336

mathematics grades, so a more than two point increase is extremely significant (Aldrich & Nelson, 1984; Astin & Astin, 2000; Bickman, Hedrick, & Rog, 1993; Bok, 1996).

Ordered logistic regression may also be expressed as a probability. Figure 7 provides predicted probabilities of mathematics achievement given the number of years attended *juku*. The predicted probability of a student with 0-1 years of *juku* having a low level of mathematics achievement is 0.1906, while a student with 6-7 years of *juku* having a low level of mathematics achievement is much less at 0.0347. On the opposite end of the spectrum, the predicted probability of a student with 0-1 years of *juku* having a high level of mathematics achievement is 0.3537, while a student with 6-7 years of *juku* having a high level of mathematics achievement is more than double that amount at 0.7817. Overall tests of the parallel regression/proportional odds and other assumptions were met.

Figure 7. Predicted probabilities of mathematics achievement (acadachvt) based on number of years attended *juku* (q13).

Number of years attended *juku*	Predicted Probability of Outcome 1	Predicted Probability of Outcome 2	Predicted Probability of Outcome 3
1	0.1906	0.4556	0.3537
2	0.0843	0.3323	0.5834
3	0.0347	0.1835	0.7817

The analysis confirms that educational equity in Japan is affected by the ability of the middle- and upper-classes to pay for the extra schooling in private *juku* that less wealthy parents are unable to provide. *Juku* have become such an indispensable part of a student's college preparation that those who can afford it attend. The most successful *juku* (measured by the

Journal of Mathematics and Culture
November 2010 5 (2)
ISSN – 1558 - 5336

number who pass the elite universities' exams) have become so profitable that they are able to hire the best teachers and use the newest technology to evaluate and monitor performance.

West Cram School

West Cram School is among the most prestigious and reputable cram schools in all of Japan. Over a period of several years, I worked at the West Cram School in Shibuya primarily with the Director of Operations and the General Manager. As one of the largest providers of supplemental education in the country, research at West Cram School has much to offer in terms of understanding the intersections of private and public sectors in Japan. I will begin with a general overview of the West Cram School and its educational strategies.

There are 37,500 fourth through sixth grade students enrolled in West Cram School nationwide. Approximately 12,000 are in the fourth grade, 13,000 are in the fifth grade, and 12,500 are in the sixth grade. Of that figure, 29,000 of the students reside in the Tōkyō area. West Cram School is divided into three main regions: Tōkyō (Chiba, Kanagawa, Saitama), Kansai (Ōsaka, Kobe), and Kyūshū (Fukuoka, Kagoshima). In Tōkyō, more than 20% of students in the fourth through sixth grades attend *juku*. Each year, West Cram School provides 33.5% of the students to the top ten private junior high schools in the Tōkyō area (Gonzales, Calsyn, Jocelyn, Mak, Kastberg, Arafeh, Williams, & Tsen, 2001; Nichinōken, 2007). This is the highest and most distinguished figure in the country. Most students attend public elementary schools, but their parents send them to private junior high schools, high schools, and universities.

Students generally attend West Cram School three times per week (Monday, Wednesday, Friday) from 16:50-20:45. There are three 70-minute periods with a five minute break between

Journal of Mathematics and Culture
November 2010 5 (2)
ISSN – 1558 - 5336

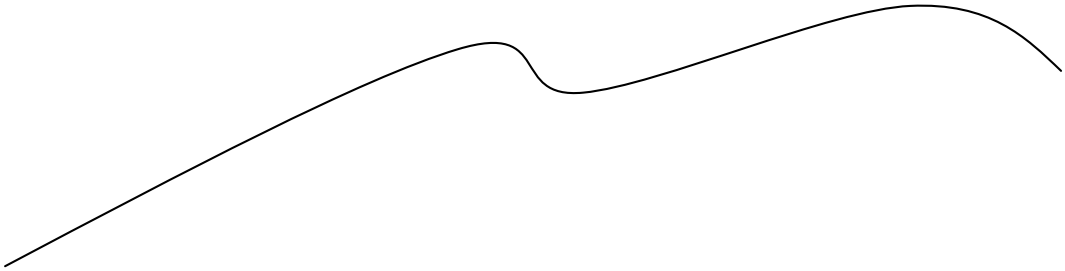
Periods 1 and 2, and a 15-minute dinner break between Periods 2 and 3. The subject content mainly focuses on mathematics, social studies, science, and Japanese national language (*kokugo*). Tuition is based on the number of subjects taken (two or four), grade (fourth, fifth, or sixth), ability tracking group (red—highest, white—middle, or gray—lowest), and the number of months students enroll in West Cram School. For example, a sixth grade student in the red group, enrolled in four classes, and attending classes year-round (there are 40 days of summer vacation and students attend West Cram School 20 of those days), pays a monthly tuition of approximately U.S. $800-1000. The tuition covers items such as registration, test fees, textbooks, science lab fees, handouts, and other resources.

The diagram in Figure 8 represents themes and periods of change within the West Cram School education strategy as described by the General Manager. In 1980, the focus was on passing the examination, followed by a shift in the 1990s to preparing students for a successful higher education transition. The drop in 1995 is an effect of shifting to a business model that was based on accruing as many students as possible. In 2000, West Cram School aspired to increase learning and the quality of education. That is the trend West Cram School has been continuing through 2009. The slight decrease toward the end is because West Cram School sees room for improvement in education for all students rather than the overreliance on entrance examination-driven preparation.

Figure 8. Education strategies and foci of West Cram School

1980 (exam-centered)	1990 (higher education)	2000 (learning, quality)	2009
合格	進学	学習	

Journal of Mathematics and Culture
November 2010 5 (2)
ISSN – 1558 - 5336



In each period, the West Cram School aimed to fulfill its mission of "meeting the needs of students through complementary education to their six years of elementary schooling" (Asai, M., personal communication, March 1, 2006). Today, West Cram School realizes there is still a strong focus on examination preparation, however, in light of global pressures to make education accessible to all there is an emphasis on quality. Teachers and staff strive to promote the character of students in relation to the greater society through structural and pedagogical strategies, such as the "Inventing the Future" Project where students discuss values, personal philosophies, and how these will affect their future careers and life decisions. As a leader in academic achievement, especially mathematics and sciences, developments in Japan have an impact on U.S. education. Several applications will be explored in the next section on sector relationships in the U.S.

Sector Relationships to U.S. Education

The common response of *juku* and other forms of supplemental education is to cater to parents' concerns that official standards are growing more distant from the entrance examination realities of Japanese and U.S. universities. The rising attendance at the Japan's most prestigious

Journal of Mathematics and Culture
November 2010 5 (2)
ISSN – 1558 - 5336

universities by students from wealthier families undermines the egalitarian thrust of the educational system, and gives us reason to examine the U.S. case more closely (Beauchamp, 1991, 2003; Rosenbaum & Kariya, 1989). The result is that parents bridge the gaps of public schooling through the private purchase of supplemental education lessons. Privatization has created a system for the purpose of passing entrance examinations in Japan, and is forging a growing market in the U.S. Three areas that may be applicable to education in the U.S. are curriculum and assessment, teacher/parent expectations, and mathematics resources.

Curriculum and Assessment

The public sector, following a uniform curriculum through grade nine, allows for the outward appearance of equity, while the private sector, in its parallel curriculum of supplemental study, allows for the reality of a competitive world where students strive to get ahead. Since there is no direct connection between the private sector and the MEXT, the curriculum, textbooks, and lessons are designed and created by West Cram School teachers and staff generally based on entrance examinations into prestigious junior high and high schools. Curriculum is designed to push students to excel, rather than catering to the lower-achieving students. Classes at West Cram School are about one semester (minimum) - one year (maximum) faster than their public elementary school peers. For example, the fifth graders in the West Cram School class I observed were studying the same materials on division and multiplication of fractions as sixth graders at their counterparts at a nearby public elementary school.

Mastering the curriculum taught in supplemental education very often determines a

Journal of Mathematics and Culture
November 2010 5 (2)
ISSN – 1558 - 5336

student's future employment and lifestyle. There is intense pressure to succeed on achievement tests, culminating in the university entrance examination. To test well is critical for Japanese students, as universities in Japan almost exclusively base their admissions decisions on test scores. West Cram School and most privatized systems in Japan utilize weekly and monthly tests that result in the shifting of ability groups. The achievement tests assess proficiency and knowledge content of national entrance examinations, in addition to West Cram School curriculum.

The U.S. phenomenon follows this example in some respects. As in Japan, private tutoring has taken off in the United States due to the competitive pressures of high-stakes examinations. The two leading test-preparation firms in the United States, Princeton Review and Kaplan Test Prep, profit from the weight given to SAT scores in college admissions offices. U.S. parents see higher education as key to the future economic success for their children, and tutoring services benefit from the inability of public schools to address a controversial issue such as test preparation with the single-mindedness of a for-profit business.

However, there are some unique differences in the private-tutoring phenomenon in the U.S. Firms sell enrichment, remedial, and test-preparatory services, but also strengthen their product lineup with services that meet the demands of a U.S. market. Princeton Review, Kaplan, and other test preparation companies offer college guidance packages. These take advantage of parental anxiety and the inability of over-burdened high school counselors to provide close assistance in a process that is growing more competitive and strategic.

Teacher/Parent Expectations

Journal of Mathematics and Culture
November 2010 5 (2)
ISSN – 1558 - 5336

Teachers and supervisors at West Cram School frequently take on responsibilities in addition to their regular course load. Through various methods of observations, teachers know the capabilities, learning styles, and personalities of each student. Meetings are regularly scheduled to discuss the character, problem-solving style, attitude toward learning, and behavior of individual students. After combining this assessment with the performance on the four core subjects (mathematics, social studies, science, and Japanese national language), teachers determine how to best help students. The strength of this relationship transfers into personalized support and tailored expectations. On a personal level, teachers know where students live, their family backgrounds, academic challenges, and future goals. For example, a map in the main room at West Cram School pinpoints to where each student's home is located in the vicinity. Parents trust the teachers and staff at West Cram School because their children are given such close, supervised attention.

The impact of family expectations and influence on student performance should not be underestimated. Almost immediately after birth, West Cram School parents generally take a strong, vested interest in the academic development of their children. According to General Manager Ōta Katsumi, "Mothers often spend hours on academic games and other activities supportive of learning" (Ōta, K., personal communication, January 13, 2006). It is common for West Cram School parents to buy books for preschoolers, including those written in English to cultivate language skills at an early age. Most West Cram School children know how to read and write before they enter elementary school, and can do simple computations.

Once a child enters elementary school, the maternal involvement increases significantly

Journal of Mathematics and Culture
November 2010 5 (2)
ISSN – 1558 - 5336

as evidenced by quantitative and qualitative data collection. There are classes for mothers called *mama juku* that prepare the mothers in subjects their children are studying at West Cram School (Stevenson, Azuma, & Hakuta, 1986; White, 1987). Collaborative homework is considered a means for developing a sense of responsibility in the child and for molding character. This constant striving by mothers for improved performance is present throughout a child's schooling years up until university, and it is intensified by students in the supplemental education system.

In contrast to Western theories of achievement which tend to emphasize individual effort and ability, the Japanese consider academic achievement to be an outgrowth of a cooperative effort and planning. In other words, if students work hard and stay on task, they can learn. Teachers and parents at West Cram School consistently uphold the belief that "individual effort is of greater significance than individual ability" (Asai, M., personal communication, March 1, 2006). Students generally strive for, and meet, these high expectations that are not as deep-rooted in the U.S. The National Mathematics Advisory Panel (2008) advocates increased research in collaborative instruction and learning, especially through the involvement of parents, teachers, and other educators (p. 1).

Mathematics Resources

Access to resources within the West Cram School and supplemental education system is another area where differences between public and private sectors are brought to the forefront. West Cram School provides textbooks, specialized libraries, facilities, and other materials that aren't present at public elementary schools many of the children attend. These resources give students space to link the lessons to previous knowledge, control what parts of learning to use,

Journal of Mathematics and Culture
November 2010 5 (2)
ISSN – 1558 - 5336

and develop the skills to explain concepts intuitively.

In the field of mathematics, students at West Cram School have the opportunity to pursue the study of logic and critical thinking in this type of environment. Fifth grade mathematics teacher Mr. Asano regularly allows his students time to brainstorm, probe arguments, and discuss solutions. For example, one day the topic was calculating rate based on distance and time. Mr. Asano opened the class with, "Tell me what you know about rate and connect this to real-world applications" (Asano, T., personal communication, January 27, 2006). As previously explained, there are three 70 minute periods at West Cram School per evening. The first 70-minute period was solely focused on the formula, rate = distance ÷ time (□□ □ □□ ÷ □□). This solidified the foundation for proceeding to the average speed of objects during the second 70-minute period of mathematics. Students began by choosing seven moving objects and ranking them from slowest to fastest. Then, the students were allowed to use resources within West Cram School—computers, books, their notes, the internet, compasses, rulers, protractors, teachers/staff, and other mathematical tools—to calculate the speed. The groups creatively chose animals (in order, snail, sloth, dog, grasshopper, horse, rabbit, cheetah), and transportation modes (in order, cow, horse, car, boat, bullet train, airplane, space shuttle). To measure speed, the first group combined innovative resources with mathematical reasoning. They took a polygon shape to represent a snail, and moved it slowly along a ruler to measure speed and distance. One member of the group timed the movement on a West Cram School stopwatch and another confirmed distance based on Cartesian coordinates. This is an example of the types of engaging and thought-provoking experiments conducted by students under the supervision of their teachers. Students

Journal of Mathematics and Culture
November 2010 5 (2)
ISSN – 1558 - 5336

were encouraged to develop a deeper comprehension of the elementary concept.

In the National Council of Teachers of Mathematics Address "Foundations for Success" there are a number of references to mathematics resources, with an emphasis on textbooks. U.S. mathematics textbooks are extremely long—often 700-1,000 pages (p. 7). Excessive textbook length often detracts from applications such as those present at West Cram School, and can contribute to a lack of coherence. Mathematics textbooks are much smaller in many nations such as Japan with higher mathematics achievement than the U.S., thus demonstrating that the great length of our textbooks is not necessary for high achievement. Representatives of several publishing companies who testified before the panel indicated that one substantial contributor to the length of the books was the demand of meeting varying state standards for what should be taught in each grade. It is recommended that publishers make every effort to produce shorter and more focused mathematics textbooks.

Similar to the Japanese system, access to resources is another arena where the public and private sector disparities are highlighted. Because of their private nature, U.S. supplemental education programs can delve further into subject matter. Unlike public schools, they can be non-ideological about controversial topics such as preparing for high-stakes exams, for example, and teaching to the test.

Raising the level of achievement through curriculum and assessment, teacher/parent expectations, and mathematics resources are three applications that form a basis for Japanese and U.S. sector comparisons. There is much the U.S. can learn from trends in the Japanese educational system. In Japan, *juku* and the form of specific, packaged education they provide are

Journal of Mathematics and Culture
November 2010 5 (2)
ISSN – 1558 - 5336

so essential to preparatory education that some educators have gone so far as to propose ending public support of education at the elementary and secondary levels, allowing the *juku*-type education to replace public schools (Cummings, 1980; Horio, 1994; Okano & Tsuchiya, 1999). While this is not expected to occur in the U.S., the benefits of supplemental education based on the three areas of comparisons are consistently documented in the records of entrance examinations into junior high school, high school, and university (Aso & Amano, 1983; Cummings, Beauchamp, Ichikawa, Kobayashi, & Ushiogi, 1986; Tsukada, 1991).

Further Discussion

In order to explore the research question of mathematics education as a public good or private commodity, I began with a portrait of the major role supplemental education plays in ensuring the success of Japanese students, both on tests administered within the country and international comparisons made on the basis of mathematics achievement test scores. The growing pressure to succeed on examinations is taking a toll in Japan, with educators questioning its impact, both on growing disparities between the wealthy and poor and the fact that tests are starting to determine curriculum.

Data collected at West Cram School, one of the largest and most reputable providers of supplemental education in the country, shows the degree to which the private sector is influential in shaping Japanese education. Upper level elementary school students (fourth – sixth grades) were selected based on the experiences in the rite of passage into adolescence and adulthood. Understanding how children balance culture, peers, academics, and other processes offers a valuable opportunity to examine their impact on educational achievement. This was

Journal of Mathematics and Culture
November 2010 5 (2)
ISSN – 1558 - 5336

accomplished by observing academic classes, extracurricular activities (i.e., sports practices, music rehearsals, tea ceremonies, language clubs, etc.), supplementary education institutions, and school cultural festivals.

The trends of students attending *juku* by school were very revealing about the types of students with access to supplemental education. Number of years attended *juku* is a good indicator of time, resources, and financial investment of parents in their children. 26.15% of students at North Elementary School, 21.18% of students at South Elementary School, 13.92% of students at East Elementary School, and 42.22% of students at West Cram School had attended *juku* 2-5 years. Ordered logistic regression showed that there was a statistically significant relationship between mathematics achievement and the number of years students attended *juku* at the 0.05 α-level ($p = 0.049$). The analysis highlighted the effect of socioeconomic class and the ability to pay for the extra schooling in the private sector on mathematics achievement.

Qualitative data also sharpened recurring questions about social inequality. Participant observations and focus group interviews provided a lens to view three examples of the symbiotic relationship between the public and private sectors in the Japanese and U.S. educational systems: curriculum and assessment, teacher/parent expectations, and mathematics resources. Although there appears to be growing concerns about the *juku* in Japan and the incredible pressure placed on Japanese students, there is still widespread support among the population for these schools. Even with varying enrollment according to the size and location of cities, with a much higher participation rate of students in metropolitan areas, over 40% of sixth graders nationwide attend

Journal of Mathematics and Culture
November 2010 5 (2)
ISSN – 1558 - 5336

juku (MEXT, 2006). Situations are developing in which private tutoring businesses may help to support official standards in the U.S., following Japan's lead. Private U.S. companies see a potential market in the nation's public school systems whose students perform poorly on standardized tests. Such tests are increasingly administered by state education departments to monitor school instruction and student achievement. Business firms hope to sell test preparation programs that will strengthen U.S. student performance, particularly in mathematics and science fields.

Throughout research, concurrent enrollment as a Visiting Scholar at the University of Tōkyō and maintaining connections with the four research sites provided complementary macroperspective analysis and access to databases at the national level, as well as hands-on learning within the classroom environment. This study was a cooperative project, supported by the University of Tōkyō, Waseda University, Ōbirin University, University of California, Los Angeles, and the MEXT.

Parents in both Japan and the U.S. seem committed to spending the money and time having their children enrolled in supplemental education classes to give them a competitive advantage in the testing to determine which high schools, colleges, and universities they may attend. Although the MEXT and U.S. Department of Education seem to be concerned about the greater pressure being placed on students to succeed on tests, the reality is that they have just begun to address issues of equity and accessibility as seen through curriculum, assessment, teacher/parent expectations, and increased mathematics resources, in a system that will ensure education is provided as a public good (NAEP, 2008; MEXT, 2006).

References

Aldrich, J. & Nelson, F. (1984). *Linear Probability, Logit, and Probit Models: Quantitative Applications in the Social Sciences.* Newbury, California: SAGE Publications, Inc.

Amano, I. (1990). *Education and Examination in Modern Japan.* Tōkyō, Japan: Tōkyō University Press.

Aso, M., & Amano, I. (1983). *Education and Japan's Modernization.* Tōkyō, Japan: Japan Times.

Astin, A., & Astin, H. (2000). *Leadership reconsidered: engaging higher education in social change.* Battle Creek, MI: W.K. Kellogg Foundation.

Baker, D. (2001). "TIMSS-R: Innovation in international information for American educators." *Education Statistics Quarterly, 3*(1), 17-19. Washington, D.C.: National Center for Education Statistics.

Beauchamp, E. (ed.). (1991). *Windows on Japanese Education.* Westport, CT: Green Press.

Beauchamp, E. (2003). *Comparative Education Reader.* New York, NY: Routledge.

Bennett, W. (1987). "Looking at Japanese Education: Implications for American Education." NASSP Bulletin, Vol. 71(499), pp. 102-108.

Bickman, L., Hedrick, T., & Rog, D. (1993). *Applied research design: a practical guide* . Thousand Oaks, CA: Sage Publications.

Bok, D. (1996). *The state of the nation: government and the quest for a better society.* Cambridge, MA: Harvard University Press.

Boyatzis, R. (1998). *Transforming qualitative information: thematic analysis and code development.* Thousand Oaks, CA: Sage Publications.

Buraku Kaihō Kenkyūsho. (ed.). (1983). *The Road to a Discrimination-free Future.* Ōsaka, Japan: Buraku Liberation Research Institute.

Clune, W., & Witte, J. (eds.). (1990). Choice and Control in American Education, *Volume 1: The Theory of Choice and Control in American Education.* New York, NY: Routledge.

Cozzens, M., & Fuhrman, S. (2001). "Invited Commentary: Lessons from the Third International Mathematics and Science Study-Repeat." *Education Statistics Quarterly, 3*(1), 17-19. Washington, D.C.: National Center for Education Statistics.

Cummings, W. (1980). *Education and Equality in Japan.* Princeton, NJ: Princeton University Press.

Cummings, W., Beauchamp, E., Ichikawa, S., Kobayashi, V., & Ushiogi, M. (1986). *Educational Policies in Crisis, Japanese and American Perspectives.* New York, NY: Praeger in association with the East-West Center.

DeCoker, G. (2002). *National Standards and School Reform in Japan and the United States.* New York: Teachers College Press.

Duke, B. (1986). *The Japanese School: Lessons for Industrialized America.* Tōkyō, Japan: Tōkyō University Press.

Duke, B. (1989). *The Great Educators of Modern Japan.* Tōkyō, Japan: Tōkyō University Press.

Fetterman, D. (1998). *Qualitative approaches to evaluation in education: the silent scientific revolution*. New York: Praeger.
Hanushek, E., & Luque, J. (2003). Efficiency and Equity in Schools around the World. *Economics of Education Review, 22*(5), 481-502.
Hess, R., Holloway, S., & McDevitt, T. (1986). Family influences on achievement in Japan and the United States. In Harold Stevenson, Hiroshi Azuma, and Kenji Hakuta, eds., *Child Development and Education in Japan*, pp. 181-194. Tōkyō, Japan: Shibundō.
Horio, T. (1994). *Education in Modern Japanese*. Tōkyō, Japan: Tōkyō University Press.
Ishida, H. (1993). *Social Mobility in Contemporary Japan: Educational credentials, class and the labour market in a cross-cultural perspective*. London, England: Macmillan Press.
Kariya, T., & Rosenbaum, J. (1987). Self-Selection in Japanese Junior High Schools: A Longitudinal Study of Students' Educational Plans. *Sociology of Education, 60*(3), 168-180.
LeTendre, G., Baker, D., Akiba, M., Goesling, B., & Wiseman, A. (2001). "Teacher's Work: Institutional Isomorphism and Cultural Variation in the U.S., Germany, and Japan." *Educational Researcher, 30*(6), 3-15.
Levin, H. (1990). "The theory of choice applied to education." In William Clune and John Witte, eds., *Choice and Control in American Education, Volume 1: The Theory of Choice and Control in American Education*, pp. 247-284. London: Routledge.
Lewis, C., & Tsuchida, I. (1988). Teaching is Cultural. *American Educator, 22*(4), 12-17.
Monbushō. (1997). Gakkō Kyōin Tōkei Chōsa Hōkokusho Heisei 7 Nendo. Tōkyō, Japan: Monbushō.
Nakajima, K. (1989). "Narusa Jinzo." In Benjamin Duke, ed., *The Great Educators of Modern Japan*, pp. 67-85. Tōkyō, Japan: Tōkyō University Press.
Nakauchi, T. (1986). *The Modernization of Japanese Education.* Tōkyō, Japan: International Society for Educational Information.
National Assessment for Educational Progress (NAEP). (2001). *The Nation's Report Card Mathematics 2000*. Washington, D.C.: U.S. Department of Education.
National Assessment for Educational Progress (NAEP). (2008). *The Nation's Report Card Mathematics 2007*. Washington, D.C.: U.S. Department of Education.
National Center for Education Statistics (NCES). (2003). *Teaching Mathematics in Seven Countries: Results from the TIMSS 1999 Video Study*. Washington, D.C.: U.S. Department of Education.
National Mathematics Advisory Panel. (2008). *Foundations for Success: The Final Report of the National Mathematics Advisory Panel*. Washington, D.C.: U.S. Department of Education.
Nichinōken. (2007). General Catalog. Tōkyō: Nichinōken Press.
Office of Educational Research and Improvement (OERI). (1988). *The educational system in Japan: Case Study Findings*, pp. 41, 218-236. Washington, D.C.: U.S.

Department of Education.
Okano, K., & Tsuchiya, M. (1999). *Education in Contemporary Japan: Inequality and Diversity*. London: Cambridge University Press.
Reich, R. (1992). *The Work of Nations. Preparing Ourselves for Twenty-First Century Capitalism*. New York: Vintage Books.
Rog, D., & Bickman, L. (1998). *Handbook of applied social research methods*. Thousand Oaks, CA: Sage Publications.
Rohlen, T. (1983). *Japan's High Schools*. Berkeley, CA: University of California Press.
Rosenbaum, J., & Kariya, T. (1989). From high school to work: Market and institutional mechanisms in Japan. *American Journal of Sociology, 16*(1), 134-165.
Sasagawa, K. (1993). Gaikokujin no gakushūken mondai to 'posutokokuminkyōiku-jidai' no kyōiku-gaku. *Kyōiku, 43*(2), 16-27.
Sōmuchō Tōkeikyoku. (2006). *Japan Statistical Yearbook 2005/2006*. Tōkyō, Japan: Sōmuchō.
Stevenson, H., Azuma, H., & Hakuta, K. (1986). *Child Development and Education in Japan*. Tōkyō: Shibundō.
Stigler, J., & Hiebert, J. (1988). Teaching is Cultural. *American Educator, 22*(4), 4-11.
Stigler, J., & Hiebert, J. (1999). *The Teaching Gap: Best Ideas from the World's Teachers for Improving Education in the Classroom*. New York: Free Press.
Tsukada, M. (1991). *Yobiko Life: A Study of the Legitimation Process of Social Stratification in Japan*. Berkeley, CA: Institute of East Asian Studies.
Tyack, D. (1974). *The One Best System*. Cambridge, MA: Harvard University Press.
U.S. Department of Education. (1997). *International Comparisons of Entrance and Exit Examinations*. Washington, D.C.: Office of Educational Research and Improvement.
Vogel, E. (1979). *Japan as number one: lessons for America*. Cambridge, MA: Harvard University Press.
White, M. (1987). *The Japanese Educational Challenge*. New York: Free Press.
Whitty, G., & Edwards, T. (1998). School choice policies in England and the United States: An exploration of their origins and significance. *Comparative Education, 34*(2), 211-227.