The Effect of Cramming Schools on Students’ Mathematics Achievement

Ju-shan Hsieh∗

ABSTRACT

The aim of the present study is to examine the correlation between children’s mathematics achievement and whether they attend extra-curricular tutoring program. Three different types of cramming schools were discriminated: (a) private, or one-on-one tutoring; (b) “Pu Hsi Pan,” a group of students with a teacher who provides instruction; and (c) “Um Chin Class,” which is a group of students with an adult who does not provide instruction. The effect of these factors, students’ attitude toward cramming schools, the types of cramming schools, student’s parental education, and their motivation to attend cramming schools on their mathematics achievement, was investigated. Participants from third to sixth grades were chosen in one of primary school in eastern Taipei. To combine student’s father and mother education, the row and column with multidimensional association model (RC(M)) was applied. To inquiry the relationship among grades, parental education, and the probabilities of attending cramming schools, the logistic regression was used. The results indicated that the effects of cramming schools varied in different grade levels. Additionally, the probabilities of attending cramming schools were associated with grade levels and parental education.

Key words: The cramming school, private tutor, Pu Hsi Pan, Um Chin Class, the row and column multidimensional association model, the logistic regression.

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INTRODUCTION

Many primary students attend cramming schools after class. Sun (1993) reported that students attend cramming schools can be attributed to Taiwan's educational environment. Sending children to cramming school is a prevailing fashion in Taiwan. The reasons that Sun proposed were: (a) Parents do not have time to take care of their children, (b) parents hope that their children will have high academic achievement in school, and (c) parents are not satisfied with public school education. Sun (1993) pointed out that parents send their children to cramming schools because they have high expectations for their children’s future. Parents believe that their children will obtain higher achievement levels in school by attending cramming schools at the elementary level. That is, higher achievement at a young age better prepares their children for academic work at the secondary level, which in turn is a key factor in their children’s preparation for high school entrance examination.

While many children attend cramming schools, the issue of attending cramming schools is controversial. There is a substantial public debate about the positive effects and negative effects of cramming schools.

The Positive Effects of Cramming Schools

Scholars who discuss the positive influence of cramming schools have argued that students have the opportunity to learn more in cramming schools (Chen, 1978; Huang, 1993; Wang, 1983; Wu, 1993). Specifically, both Chen (1978) and Huang

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(1993) pointed out that most students went to improper places after school classes were over (e.g., gambling houses, video arcades, dancing halls). However, cramming schools provide a good learning environment for students. Parents need not worry about what their children may be doing after regular classes. Chen also argued that it was reasonable for teachers to earn extra income by working as instructors at cramming schools and students had the chance to learn what they did not understand in school. He also quoted a statement made by Wen-Chuan Chan, who was a congressman in Taichung. Chan said that "students could not understand all class materials from regular class, so students attending cramming schools was necessary." Chen suggested that the government agency in charge of the educational institute should take advantage of the cramming schools, understand parents' expectations for their children, and help students improve their academic achievement by attending cramming schools. Another advantage presented by Huang (1993) is that if students attending cramming schools achieve higher academic levels, then they will be labeled as “good” students. Students labeled as “good” students have good academic achievement in modern society. On the other hand, students labeled as “bad” students have poor academic achievement. Students will be honored if they belong to the high academic groups and normally teachers like them better. Cramming schools provide the opportunity for students to attain higher levels of achievement than they otherwise could have attained without the extra practice assistance obtained in cramming schools. Unfortunately, Chen (1978) and Huang (1993) did not support their arguments with empirical studies.

The Negative Effects of Cramming Schools

These educators have reported that school teachers who teach in cramming schools may not concentrate on their school classes because the teachers explain the lecture in detail in cramming schools instead of in public schools (Chang, 1980; Tang, 1979; Wu, 1978). Thus, parents who are afraid that their children cannot achieve good academic scores in public schools feel forced to send their children to cramming schools (Chang, 1980). Additionally, because students spend so much time on their academic work, they do not have a chance to develop other talents, such as
music or art skills (Tzeng, 1980). Furthermore, Huang (1993) argued that the cramming schools could limit the development of students’ creative abilities in more academic areas in that students have to practice the same questions by using the methods they are told to prepare their school examinations. Students' creative ability may be ruined by repeating the mechanical calculations. Tang (1979) indicates that cramming schools could hurt students' mental and physical development. The students who do not attend cramming schools could feel that their teachers discriminate against them. Students could feel that it was unfair and thus would feel compelled or forced to attend a cramming school to get equitable treatment from their teachers.

The Purpose of the Present Study

Almost no similar studies in Taiwan address whether different types of after-school tutoring programs (one-on-one tutoring, "Pu Hsi Pan" (PHP), and "Um Che Class" UCC) lead to differential effects on students’ achievement. The instructors in UCC do not provide a supplementary curriculum for students (Educational Institute, 1988), while instructors in PHP do provide a supplemental curriculum for students. Furthermore, existing studies did not consider the potential effects of such factors as the level of parental education, students’ grade level, students’ attitude toward their tutoring programs, or the reason that students attend a tutoring program. The purposes of the present study can be summarized by the following three questions:

1. Do students who attend cramming schools and students who do not attend differ with respect to their mathematics achievement, statistically controlling for parental education level? If so, are the differences the same in different grade levels?

2. Do students’ mathematics scores differ with respect to their parental education, their attitude toward cramming schools, the reasons for attending cramming school, and the three different types of cramming school? If there are differences, are the effects the same in different grade levels?

3. Is there a relationship between parental education level, student grade level, and enrollment in a tutoring program? If so, what is the nature of the relationship?
METHOD

Participants
In an effort to better understand the possible effects of cramming schools, a study was conducted among students in one of the public elementary schools in eastern Taipei. Because the procedure of data collection was confidential, only one school was considered. There were 13 third grade classes and 14 classes each of fourth, fifth, and sixth grades in this elementary school. A subset of six classes in the third and fourth grades was randomly selected. Students in selected classes were used in this study, 240 students in the third grade and 277 students in the fourth grade. Because the rate of attending after school programs in higher grade levels was high, all students in the fifth and sixth grades were selected, 372 students in the fifth grade and 413 students in the sixth grade.

Instrumentation
Two instruments were used to collect data. These instruments and the variables were:

1. Students in the same grade in the elementary school used in the study took the same monthly examination at the same time. I used students' mathematics scores on the second month examination as a measure of mathematics achievement. The examination included multiple choice, fill-in-the-blank, matching, and applying questions.

2. Students' questionnaire: The questionnaire included three parts, a personal data form, information about cramming schools, and an attitude-toward-cramming-school scale.

   Personal Data Form. It included information about a student's family background, gender, parental education, and the student’s grade.

   Information on Cramming School. Students were asked whether they went to a cramming school. If they did, then they responded to questions about which type of cramming school they attended, whether they took mathematics lessons in cramming school, and the primary reasons they had for going to cramming school.

   The Attitude Scale. Students who attended cramming school were asked to respond to six questions, which comprised an attitude-toward-cramming-school scale. The questions were included in Appendix A. The six questions used a Likert-response
scale and all questions dealt with the information about the students’ attitude toward cramming schools. Coefficient alphas for the attitude scale for third grade, fourth grade, fifth grade, and sixth grade were 0.73, 0.76, 0.56, and 0.71, respectively.

PROCEDURES

The data for this study were collected in May 1995. The second month mathematics scores, were recorded by their mathematics teachers; the personal data form, the information on cramming schools, and the attitude scale were distributed in class to 1299 students across all four grade levels. The questionnaires were completed during class time and collected after students finished.

STATISTICAL ANALYSIS

The RC(M) association model was used to scale the parental educational levels for use in later analyses. The amount of education of the parents is an important variable in this study; however, there are two possible measures: (a) the mother’s education and (b) the father’s education. To answer the research questions involving the level of parental education, a new numerical variable was constructed by using the multidimensional row and column (RC(M)) association model. The values of the new variable were used in analyses that investigate the main research questions of this study.

The six levels by which each student’s mother and father educational level was classified were: (a) none; (b) graduated from elementary school; (c) attended junior high school but did not go to senior high school; (d) attended senior high school but did not go to college; (e) attended college but did not go to graduate school; (f) attended graduate school or post-graduate work.

When students’ parents attend college but did not graduate from college, the coding was classified their parents graduate from college and so on. To obtain the values of the new variable, the RC(M) association model (Clogg & Shihadeh, 1994) was utilized to scale the values of the father's education and the mother's education. Because both the father's and the mother's education were measured discretely (i.e., were
categorical data), the data used here consist of students of frequencies cross-classified by their father’s and mother’s education. The model of goodness of fit is given in Table 1.

The RC(M) association model is:

$$\ln(F_{ij}) = \lambda + \lambda_i^F + \lambda_j^M + \sum_{d=1}^{D} \phi_{jd} \mu_{id} \nu_{jd}$$

where $\lambda$ is the overall term, $\lambda_i^F$ is the marginal effect of the $i$th level of the father’s educational level, $\lambda_j^M$ is the marginal effect of the $j$th level of the mother’s educational level, $\phi_{jd}$ is a measure of the strength of the association between the two variables on the $d$th dimension, $\mu_{id}$ is the scale value of the $i$th father’s educational level on the $d$th dimension, and $\nu_{jd}$ is the scale value of the $j$th mother’s educational level on the $d$th dimension.

To choose which model was the "best" in the present research, an analysis of association was performed, which considers:

$$\Delta G^2 = G^2_{\text{simple}} - G^2_{\text{complex}}$$

Thus, $\Delta G^2$ indicates how much the maximum likelihood ratio statistic is reduced (i.e., change in lack of fit of the model); however, this statistic is not distributed as a chi-square random variable. Therefore, the statistical tests on $\Delta G^2$ are not valid.

$G^2_{\text{simple}}$ is the maximum likelihood ratio statistic of the independence model and

$G^2_{\text{complex}}$ is the maximum likelihood ratio statistic of the second model, RC(1). In Table 2, the percent of lack of fit is

$$\text{The percent lack of fit} = \frac{\Delta G^2}{G^2_{\text{Independence}}} \times 100\%$$

where the $G^2_{\text{Independence}}$ is the maximum likelihood ratio in the independence model. The percentage of lack of fit accounted for by the one-dimensional model is 84.27%, (620.95 - 95.70)/620.95 * 100% = 84.27%. The percentage of dependency between the mother’s and father's education as measured by the one-dimensional model excluding the (6, 1)
The percentage of lack of fit accounted for by the RC(2) model equals 98.20%, (620.95-11.21) /620.95 = 98.20%; however, the simpler model (i.e., RC(1) without cell (6,1)) was used to scale the values of the father’s and mother’s education. The new variable, "level of parental education", is simply the sum of the scale values; that is,

\[
\text{Parental educational level} = \mu + \nu.
\]

This new variable is an interval level measure and is treated as a continuous numerical variable in the analyses presented in the results section that addresses the three research questions of this study.

**RESULTS**

This section illustrated the results of the three research questions, which were indicated as follows.

**Enrollment in Cramming School and Mathematics Achievement**

The first research question is whether students attend or not attend cramming schools have different mathematics scores, while controlling for parental educational levels.

For third graders, whether students attended cramming schools was a significant predictor of mathematics scores (t(176) = -2.18, p < .05); however, because the parameter estimate (\( \hat{\beta} = -1.81 \)) was negative, which indicated that students who did not attend cramming schools achieved higher mathematics scores. The second explanatory variable, parental educational level, was significant (t(176) = 2.4, p < .05). The estimated coefficient (\( \hat{\beta} = 4.38 \)) indicated that students were prone to have higher mathematics scores when their parental educational levels were higher. These two explanatory variables yielded a small \( R^2 \)-squared value (\( R^2 = .07 \)). Only 7% of the variance can be explained by these two independent variables.

For students in the fourth grade, the variable, attending cramming schools, was not significant (t(175) = -1.77, p > .05), which did not have sufficient evidence to support the
differences in students' mathematics scores. The second explanatory variable, students' parental educational levels, was not significant ($t(175) = 0.37, p > .05$), which showed that parental educational levels were not associated with students' mathematics scores.

In the fifth grade, the results indicated that the differences between students attending and not attending cramming schools was not significant ($t(266) = 0.45, p > .05$). On the other hand, parental educational level was significant ($t(266) = 5.79, p < .05$), which showed that students achieve better mathematics scores as parental educational levels become higher. The value of R-square was 0.11, which indicated these two explanatory variables explain 11% of the variance in the students' mathematics scores.

For sixth graders, the results indicate there was an interaction between the two explanatory variables ($t(318)=-8.92, p < .05$) and the $\beta$ value was negative. To interpret the interaction effect, the equation of the multiple regression was examined. The equation is:

$$ Y = \beta_0 + \beta_1 \cdot \text{Cramming School} + \beta_2 \cdot \text{Parental Education} + \beta_3 \cdot \text{Cramming School} \times \text{Parental Education} $$

where $\beta_0$ is the intercept (a constant), $\beta_1$ is the coefficient of cramming schools, $\beta_2$ is the coefficient of parental education, and $\beta_3$ is the interaction coefficient between cramming schools and parental education. Inserting the estimated coefficients into the above equation yields:

$$ Y = \beta_0 + 2.5 \cdot \text{Cramming School} + 9.55 \cdot \text{Parental education} - 8.92 \cdot \text{Parental education} \cdot \text{Cramming School} $$

Because the types of cramming schools had two levels, which were effect coded, the equation for those students who attended cramming school (i.e., cramming school = 1) is:

$$ Y = 69.04 + 2.5 + 1.37 \cdot \text{Parental education}. \quad (1) $$

The equation for students who did not attend cramming schools (i.e., cramming school = -1) is:

$$ Y = 69.04 - 2.5 + 18.47 \cdot \text{Parental education}. \quad (2) $$

The slope of the line for those not attending cramming schools was steeper than those did. The results presented that parental education played a role when children did not
attend cramming schools. However, if they attended cramming schools (i.e., equation 1), their parental education did not have as much influence (i.e., equation 2).

**Differences Among Those Who Attend Cramming Schools**

The second research question explored whether students' mathematics scores differ correlating on the types of cramming school attended, student’s attitude toward his/her cramming school, and their primary reason for attending cramming school, while controlling for parental educational level. Multiple regression was also used to address this question. The dependent variable was students' mathematics scores. The four explanatory variables were types of cramming school, students' attitude toward cramming school, students' primary reasons for attending cramming school, and parental education. Because of the three types of cramming school (i.e., private tutor, PHP, and UCC), two-effect coded variables (C1, C2) were used in the regression for the variable “Type of Cramming School.” The variable C1 equaled 1 for students with a private tutor, -1 for those who attended UCC, and 0 otherwise. The variable C2 equaled 1 for students who attended PHP, -1 for those who attended UCC, 0 otherwise. The two reasons for students attending cramming schools were: Students wanted to attend and students were forced to attend by their parents. Effect coding was used for these two reasons (i.e., students’ motivation) such that R1 equals 1 for students who wanted to go to cramming school and R1 equaled -1 for those who were forced to attend by their parents. Students’ attitude was a numerical variable with higher scores indicating a more positive attitude to cramming schools and lower scores indicating a more negative attitude to cramming schools.

The results for the third grade, C1 was not significant ($t(46) = -1.58, p > .05$), and neither was C2 ($t(46) = -1.05, p > .05$). Students' attitude toward cramming schools was significant ($t(46) = 2.62, p < .05$). The estimated regression coefficient for attitude (i.e., $\hat{\beta} = 1.03$) indicated that students who had a more positive attitude toward cramming school tended to achieve higher mathematics scores. Although parental education showed no main effect, there is a significant interaction between a student's parental education and the effect of private tutor versus average score (C1) ($t(46) = 2.95, p < .05$).
To interpret the direction of the interaction, the equation of the multiple regression equation was examined. The equation is:

\[ Y = 65.50 + - 4.8 \times (C1) - 2.66 \times (C2) + 15.29 \times (\text{Parental education}) \times (C1) - 4.55 \times (\text{Parental education}) \times (C2). \]

Because \( C1 = 1 \) and \( C2 = 0 \) for the treatment effect of students having private tutors, the equation is:

\[ Y = 65.50 - 4.8 + 15.29 \times (\text{parental education}). \quad (3) \]

Because \( C1 = 0 \) and \( C2 = 1 \) for the treatment effect of students attending PHP, the equation is:

\[ Y = 65.50 - 2.66 - 4.55 \times (\text{parental education}). \quad (4) \]

Because \( C1 = -1 \) and \( C2 = -1 \) for the treatment effect of students attending UCC, the equation is:

\[ Y = 65.50 + 7.46 - 10.74 \times (\text{Parental education}). \quad (5) \]

The coefficients of parental educational levels in the three equations were different. Because the coefficient for “parental education” was positive in the third equation (15.29), the students who had private tutors showed better mathematics achievement as parental education became higher. Because the coefficient of “parental education” was negative (-4.55), students who attended PHP had higher math scores as parental education were lower. The fifth equation showed the coefficient of parental education was negative (-10.74), which indicated that students who had higher math scores when parental education became lower. To compare the three regression coefficients for “parental education,” the coefficient for the third equation was the largest (15.29), the coefficient for the fourth equation was the lowest (-4.55). The results indicated students’ mathematics score correlated significantly on their parental education if they had private tutor and less on their parental education if they attend PHP. When students attended UCC, their mathematics achievement correlated more on their parental education than those who attend PHP, but correlated less on their parental education than those who have a private tutor. The value of \( R^2 \)-squared (\( R^2 = .28 \)) indicated that the interaction between cramming schools and parental education and students' attitude toward cramming schools may explain 28% of the variance in their mathematics scores.

For students in the fourth grade, the explanatory variable, students’ motivation, was deleted because it was highly correlated with the variable of students attitude toward
cramming schools, multicollinearity (r = .35, p < .05). The contrast C2 was shown in the final model, because the p-value of the contrast was close to the significant level. The results showed that the types of cramming schools was not significant (F(2, 68) = 3.04, p > .05). Students' attitude toward cramming school showed a significant effect (t(68) = 1.03, p < .05), which indicated that students who had a more positive attitude toward cramming school showed better mathematics scores. The value of R-squared was equal to 0.18. The two explanatory variables can explain 18% of the variance.

For students in the fifth grade, the variable of students’ motivation was shown in the final model because it was close to the significant level. The results showed that the interaction between students attending different types of cramming schools and parental education was significant, F(2, 85) = 4.88, p < .05. Specifically, the interaction between parental education and the treatment effect of PHP versus average score (C2) was significant (t(85) = -2.51, p < .05). The equation is:

\[ Y = 84.42 - 3.45 \times (C1) + 7.5 \times (C2) + 12.71 \times \text{(parental education)} + 1.1 \times (C1) \times \text{(parental education)} - 11.82 \times (C2) \times \text{(parental education)}. \]

For the effect of students having private tutors (i.e., C1 = 1 and C2 = 0), the equation with the interaction is:

\[ Y = 84.42 - 3.45 + 13.81 \times \text{(parental education)}. \]  
\[ (6) \]

For the effect of students attending PHP (i.e., C1 = 0 and C2 = 1), the equation with the interaction is:

\[ Y = 84.42 + 7.5 + 0.89 \times \text{(parental education)}. \]  
\[ (7) \]

For the effect of students attending UCC (i.e., C1 = -1 and C2 = -1), the equation is:

\[ Y = 84.42 + 4.05 + 23.43 \times \text{(parental education)}. \]  
\[ (8) \]

The coefficients of parental education in the three equation were positive (13.81, 0.89 and 23.43). The results indicated that students who had a private tutor, attended PHP and attended UCC showed higher mathematics achievement as their parental education became higher, and vice versa. Students’ mathematics scores correlated much on their parental education when they attended UCC, but correlated less when they had private tutor. However, the coefficient of parental education was 0.89 in the seventh equation. The results showed that the mathematics scores of students who attended PHP did not correlate as much on their parental education. Another explanatory variable, the reason
for students attending cramming schools was not significant, \( t(85) = 1.97, p > .05 \). The value of R-squared was 0.20. The interaction between parental education and the contrast C1 and C2, and the reason for students attending cramming school explained 20% of the variance.

For students in the sixth grade, no interaction effect was found between the types of cramming school and parental education, but the main effect of the types of cramming school was significant, \( F(2,157) = 12.67, p < .05 \), which indicated the types of cramming school made a difference in their mathematics scores. Upon further investigation of the three types of cramming schools in detail, C1 was significant \( t(157) = -3.92, p < .05 \), but C2 was not significant \( t(157) = 0.43, p > .05 \). The \( \hat{\beta} \) value for C1 was negative, which presented that students who had a private tutor showed lower mathematics scores. The equation with C1 and C2 is:

\[
Y = \beta_0 -11.56 \times (C1) + 0.43 \times (C2).
\]

For the effect of students having private tutor (C1 = 1 and C2 = 0), the equation became:

\[
Y = \beta_0 - 11.56 \quad \text{(9)}
\]

For the effect of students attending PHP (C1 = 0 and C2 = 1), the equation became:

\[
Y = \beta_0 + 0.43 \quad \text{(10)}
\]

For the effect of students attend UCC (C1 = -1 and C2 = -1), the equation became:

\[
Y = \beta_0 + 11.13 \quad \text{(11)}
\]

The three equations showed that students were more likely to have lower mathematics scores when they had private tutors (Equation 9), and they tended to achieve higher mathematics scores when they attended PHP or UCC (Equation 10 and 11). In Equation 10 and Equation 11 showed that students attending UCC achieve higher mathematics scores than those attending PHP (11.13 > 0.43). The main effect of students’ parental education was not significant. The results were consistent to the interaction effect. When students attended cramming schools, their parental education would not have much association with their mathematics achievement. Students’ attitude toward cramming school and the main reasons for students attending cramming schools were not significant with regard to their mathematics scores. The value of R-squared was equal to 0.14, which showed that the two explanatory variables--the three kinds of cramming schools and their parental educational levels--explain 14% of the variance.
Relationship between Attendance and Parental Education

The third research question described the relationship between students’ attendance in cramming schools and parental educational levels. To investigate this relationship, binary-logit models were used. The relationship between student’s enrollment in cramming school and parental education was analyzed for each grade level separately and also with all grades combined. In all models, the dependent variable was whether students attended cramming school. Parental educational level was also included in all models as an explanatory variable. When all grade levels were considered together (in one model), grade level was included as a second explanatory variable.

The logit model was specified by the binary outcome variable as follows (Liao, 1994):

\[
\log \left[ \frac{P(y=1)}{P(y=0)} \right] = \log \left[ \frac{P(y=1)}{1 - P(y=1)} \right] = \sum_{k=1}^{m} \beta_k \chi_k
\]

where \( P(y=1) \) is the probability that a student does not attend cramming school; the event \( P(y=0) = 1 - P(y=1) \) is the probability that a student attends cramming school; \( \chi_k \) is the kth explanatory variable (i.e., parental education or grade level), \( \beta_k \) is the parameter estimate for the kth variable. The number of explanatory variable equal 1 (i.e., \( m=2 \)) when grades are analyzed separately or 2 (i.e., \( m=3 \)) or when grades are combined, which include an intercept \( \beta_0 \). To estimate the model parameters, a logistic regression model was fit to data using SAS/LOGISTIC. The predicted probability of attending cramming school given values for the explanatory variables based on this model equals (Liao, 1994):

\[
\text{Prob} (y=1) = \frac{\exp(\sum_{k=1}^{m} \beta_k \chi_k)}{(1 + \exp(\sum_{k=1}^{m} \beta_k \chi_k))}
\]

The results of the logistic regression were given in Table 3. For students in the third grade, the coefficient of parental education was significant (\( \chi^2 (1, N = 181) = 4.16, p < .05 \)). The value of \( \exp(\hat{\beta}) \) was 2.26, which indicated that the odds that students would not attend cramming school were 2.26 times larger than the odds when parental education increases one unit on level of parental equation scale. Therefore, as parental
educational levels increases, the odds that parents send their children to cramming schools decreases. The observed proportions were calculated from the ratio of students attending cramming schools to the total number for each cell. Where the cells, correspond to the combinations of six father’s and six mother’s educational levels (i.e., 36 cells).

For students in the fourth grade, the coefficient for parental education is not significant ($\chi^2 (1, N = 178) = 2.49, p > .05$), which indicates no significant relationship exists between students’ enrollment in cramming school and their parental educational levels.

For students in the fifth grade, the coefficient for parental education was not significant ($\chi^2 (1, N = 269) = 1.90, p > .05$). The results showed that there was no significant relationship between students’ enrollment in cramming school and parental educational levels.

For students in the sixth grade, the coefficient for parental education was significant ($\chi^2 (1, N = 321) = 8.49, p < .05$). The value of $\exp(\beta)$ was 2.28, which indicated that the odds that students would not attend cramming school was 2.28 times larger than the odds when parental education increases one unit. The results were similar to those in the third grade, which means that parents with higher educational levels did not tend to send their children to cramming schools.

The results of attending cramming schools showed that the percentage increases with grade levels. When all grades were analyzed together, a second exploratory variable, the grade level, was added to the logit model. In Table 3, the parameter estimate, $\hat{\beta}_1$, for parental educational level was 0.411, and the odds of parental educational level were $\exp(\hat{\beta}_1) 1.51$, which indicated the odds that students do not attend cramming schools was 1.51 times larger than the odds when their parental educational levels were one unit larger. The second parameter estimate, $\hat{\beta}_2$, for each grade level is $-0.27$ so $\exp(-0.27) = 0.77$, which indicated as the grade level was one unit smaller, the odds of students not attending cramming schools was 0.77 times. That is, the odds that
students’ attend cramming schools is \((1/.77) = 1.31\) times larger when the grade level is one unit higher. The results indicate that children in higher grade levels are more likely to attend after school programs. The graph of predicted probability for all four grades was given in Figure 1. In Figure 1, apparently, parents with higher educational level are less likely to send their children to cramming schools. In comparison with grade levels, the probability of attending cramming schools in the sixth grade is the highest. In contrast, the probability of students’ attending cramming schools in the third grade is the lowest.

**CONCLUSION AND DISCUSSION**

This section illustrated the relationship between previous research and the current study and the implications.

With respect to the difference in mathematics scores, parental educational level showed a significant difference at the third and fifth grade levels. In the sixth grade, the interaction indicated that students attending cramming schools achieve higher mathematics scores even as their parental educational level is lower. The results are consistent with educators’ speculations in Taiwan (Chen, 1978; Huang, 1993; Wang 1993; Wu, 1993) that cramming schools have a positive effect on students’ mathematics achievement. In Grade 3, students attending cramming schools show lower mathematics scores relative to those who do not attend. The opposite results are found in the sixth grade, which imply that sending children to cramming schools may not make a difference in their mathematics scores. One possible explanation is that they may have lower mathematics scores before they attend cramming schools.

The results of the second research question show in Grades 3 and 4, a more positive attitude toward cramming school is associated with higher mathematics scores, but students’ attitude is not significant in Grade 5 and 6. This result implies that students’ attitude toward cramming schools is important at the lower grade levels but may not be as important at higher grade levels. Furthermore, the reasons may be related to their attitude toward cramming schools. Though students are forced to attend cramming schools, they may have a positive attitude toward cramming schools eventually.
The main effect of the three types of cramming schools—a private tutor, PHP, and UCC—shows a significant difference in the sixth grade and a significant interaction with parental educational level in the third and fifth grades. The results of the interaction effect show that, in the fifth grade, students’ mathematics scores do not correlate much on their parental education when they attend PHP, but their mathematics scores correlate much on their parental education when they attend UCC. This indicates that when students receive instruction in a group, they are more likely to show better mathematics scores. The reason may be due to that these students have better achievement before they attend PHP. In the sixth grade, the results presented that students have better mathematics scores if they attend UCC. On the other hand, students have lower mathematics scores when they have a private tutor. The reason for this inconsistency may be due to that the quality of private tutoring varied or students had lower mathematics scores tended to have private tutors. The main effect of parental educational level is consistent with the results from the first research question, which were not significant. In comparison with the results between the fifth and sixth grade levels, students who attended UCC achieved higher mathematics scores. It may be inferred that students did not have much difficulty understanding the content in the sixth grade.

The results in Grade 3 and Grade 6 delineated that parents with higher educational levels do not tend to send their children to cramming schools. The results are consistent with Sun’s (1993) and Wu’s (1993) studies. The results of grade levels indicate that at higher grade levels, more students attend cramming schools. The results may imply that parents at lower educational levels and students at higher grade levels may need extra help to improve their mathematics achievement. It would be interesting to see if this trend continues at the higher grade levels. Therefore, future research should include students in junior high grades (i.e., 7th-9th grades).

**AREAS FOR FURTHER STUDY**

Further study needs to consider the following factors. First, in the future study, the quality of the private tutor, such as their educational background and instructional methods, needs to be investigated. Second, it is hard to examine students' improvement
in this study because this study did not compare students' mathematics achievement on a pretest with their mathematics achievement on a posttest. This study included only one test, students' second month examination, so in the current study the change in students’ performance could not be examined. The length of time that students attend cramming schools may influence change in performance and this potential factor should be investigated. Third, the data were collected in eastern Taipei. The results may vary in different districts in Taiwan. It is possible to compare students living in Taipei suburbs with those living in Taipei to show different effects of cramming schools. The importance of cramming schools may show a difference in the suburb and city. Additionally, other factors may influence students' mathematics scores, such as the teachers, the instructional approach, and students' pressure in cramming schools, and so on.

Table 1

<table>
<thead>
<tr>
<th>Fit Statistics of the RC(M) Association Model Fit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
</tr>
<tr>
<td>Independence</td>
</tr>
<tr>
<td>RC(1)</td>
</tr>
<tr>
<td>RC(1) w/o (6,1)</td>
</tr>
<tr>
<td>RC(2)</td>
</tr>
</tbody>
</table>

Note. G² is the maximum likelihood ratio statistic, and df is degrees of freedom. RC(M) is the Mth dimensional row-column association, and the third model is the model that excludes the (6, 1) cell.
Table 2
Analysis of Association.

<table>
<thead>
<tr>
<th>Model</th>
<th>Δdf</th>
<th>ΔG²</th>
<th>%</th>
<th>Cum. %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Independence - RC(1)</td>
<td>9</td>
<td>523.25</td>
<td>84.27</td>
<td>84.27%</td>
</tr>
<tr>
<td>RC(1) - RC(2)</td>
<td>7</td>
<td>86.49</td>
<td>13.93</td>
<td>98.20%</td>
</tr>
<tr>
<td>RC(1) - RC(1) w/o (6,1)</td>
<td>1</td>
<td>42.84</td>
<td>7</td>
<td>91.17%</td>
</tr>
</tbody>
</table>

Note. % is the difference of maximum likelihood ratio between two association models, and cum % is the cumulative percentage, which is the total percentage reduced from the independence model.

Table 3
Logistic Model for Testing the Relationship Between Parental educational Levels and Their Children’s Enrollment in Cramming Schools.

<table>
<thead>
<tr>
<th>Source</th>
<th>β</th>
<th>SE</th>
<th>χ²</th>
<th>p</th>
<th>exp(β)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Grade 3</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parental education</td>
<td>0.82</td>
<td>0.40</td>
<td>4.16</td>
<td>0.04*</td>
<td>2.26</td>
</tr>
<tr>
<td><strong>Grade 4</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parental education</td>
<td>0.60</td>
<td>0.38</td>
<td>2.50</td>
<td>0.11</td>
<td>1.83</td>
</tr>
<tr>
<td><strong>Grade 5</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parental education</td>
<td>-0.42</td>
<td>0.30</td>
<td>1.90</td>
<td>0.17</td>
<td>0.66</td>
</tr>
<tr>
<td><strong>Grade 6</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parental education</td>
<td>0.82</td>
<td>0.28</td>
<td>8.49</td>
<td>0.003**</td>
<td>2.28</td>
</tr>
<tr>
<td><strong>All Grades</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade</td>
<td>-0.27</td>
<td>0.06</td>
<td>17.88</td>
<td>0.000**</td>
<td>0.77</td>
</tr>
<tr>
<td>Parental education</td>
<td>0.41</td>
<td>0.16</td>
<td>6.42</td>
<td>0.01**</td>
<td>1.51</td>
</tr>
</tbody>
</table>

Note. β is the parameter estimate, SE is standard error, χ² is Wald chi-square, and exp(β) is the odds of students attending cramming schools over those not attending cramming schools.
Figure 1. The predicted probability of students attending cramming schools for each grade level and parents' educational levels
REFERENCES


APPENDIX A

The information of attending after school programs and attitude questions.

Class _______ Name_________ ID_______

There are two sections in this questionnaire. The first section contains general questions about your background, and the second section contains questions about the tutoring program that you may be attending. There are no right or wrong answers. Your answers will only be used in this research project. Your teachers, parents, and friends will not know your responses. Thank you for completing this questionnaire.

Instructions: For questions 1-10, either circle your answer or write your answer in the blank provided.

1. What grade are you in? (1) third (2) fourth (3) fifth (4) sixth
2. What is your gender? (1) Male (2) Female
3. My father ____________ (write one choice from the following selections)
   (1) does not attend school.
   (2) has a sixth grade education.
   (3) graduated from junior high school but did not go to senior high school.
   (4) graduated from senior high school but did not go to college.
   (5) graduated from college but did not go to graduate school.
   (6) graduated from graduate school or post-graduate work.
4. My mother ____________ (write one choice from the following selections)
   (1) does not attend school.
   (2) has a sixth grade education.
   (3) graduated from junior high school but did not go to senior high school.
   (4) graduated from senior high school but did not go to college.
   (5) graduated from college but did not go to graduate school.
   (6) graduated from graduate school or post-graduate work.
5. Do you attend cramming school? (1) Yes (2) No

If you go to cramming school after class, please answer the following questions. If you do not go to cramming school, you do not need to answer any of the following questions.

6. Do you take "mathematics" in cramming school? (1) yes (2) no
7. What kind of cramming school do you go to?
   (1) I have a private tutor.
   (2) I go to "Pu Hsi Pan."
   (3) I go to "Um Chin Class."
8. What is the primary reason that you go to cramming school. (circle one)
   (1) I want to go.
(2) My parents make me go.
(3) My friends go.
(4) My teacher suggested that I go
(5) Other ________________

Instructions: For items 9-14, circle the response that best describes how much you agree or disagree with each of the following statements.

9. I like cramming school.

1 2 3 4 5
Strongly Disagree Disagree Neutral Agree Strongly Agree

10. I do not learn very much in cramming school.

1 2 3 4 5
Strongly Disagree Disagree Neutral Agree Strongly Agree

11. I like the teachers in cramming school.

1 2 3 4 5
Strongly Disagree Disagree Neutral Agree Strongly Agree

12. I want to learn as much as I can in cramming school.

1 2 3 4 5
Strongly Disagree Disagree Neutral Agree Strongly Agree

13. I have more confidence in the subjects that I study in cramming school.

1 2 3 4 5
Strongly Disagree Disagree Neutral Agree Strongly Agree

14. Cramming school is important for my achievement in regular school.

1 2 3 4 5
Strongly Disagree Disagree Neutral Agree Strongly Agree
補習班對國小學生數學成就的效用

謝如山*

摘 要

本研究論文的目的在探討是否學生上補習班與其數學成就的關連。補習班可區分三種不同的類型：(a)私人家教，一對一的教學；(b)補習班，老師在班級中提供教學；(c)安親班，老師在班級中只提供場地安置學生，但不提供教學。本研究檢視學生對補習班的態度，補習班的類型、學生父母親的教育程度、與學生去補習班的動機對他們數學成就的影響。學生的樣本來自於台北市東區一所國民小學三年級到六年級的學生。為了要將父親與母親的教育程度變為一個變項，筆者採用行列多重空間相關模式。筆者亦使用對數迴歸模式(logistic regression)來深入的探討年級、父母親教育程度與學生上補習班的機率。結果顯示上補習班的機率與年級的高低與父母親的教育程度均有相關。

關鍵詞：補習班、家教、安親班、行列多重空間相關模式、對數迴歸模式

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