

Parental Expectations and Student Performance in Secondary School Mathematics Education

Daya Weerasinghe

Abstract—Parental expectations often differ to that of their children and the influence and involvement of parents, at home, may affect the student performance in the classroom. This paper presents results from a survey of Asian and European background secondary school mathematics students ($N=128$) in Melbourne, Australia. Student responses to survey questions were analysed using confirmatory factor analysis, followed by t-tests and ANOVA. The aim of the analysis was to identify similarities and differences in parental expectations in relation to ethnicity, gender, and the year level of the students. The notable findings from the analysis showed no significant difference (at 0.05 level) in parental expectations and student performance, in relation to ethnicity or gender. Conversely, there was a significant difference in both parental expectations and student performance between year 7 and year 12 students. Further, whilst there was a significant difference in parental expectations between year 7 and year 11 students, the students' performances were not significantly different. The results suggest further research may be needed to understand the parental expectations and student performance between the lower and upper secondary school mathematics students.

Keywords—Ethnic background, gender, parental expectations, student performance, year level.

I. INTRODUCTION

IN search of factors that may affect parental involvement in mathematics education of their children, parental attitudes, beliefs, expectations, and aspirations have found to be involved in many studies. Notably, studies on learning mathematics, international comparative studies, parent-child involvement, and parenting styles, suggest that there is a relationship between parental involvement and student performance. In fact, parents play an important role in the learning and academic achievement of their children. Parental involvement motivates some children to achieve more while it creates a negative pressure on some of the other children. However, it is not parental involvement alone that determines academic success or failure of children. This paper discusses about parental expectations and the academic performance of their secondary school children.

Comparisons of international studies such as the Trends in International Mathematics and Science Study (TIMSS) and the Programme for International Student Assessment (PISA) indicate that students in many Asian countries perform better in mathematics than students in most European countries [1], [2]. Hence, the performance of students from Asian background and European background living in the same country is of interest

in this study. In addition to findings related to ethnic background, other comparisons between gender and year level of students are presented. Especially, these comparisons are based on parental expectations and academic performance of their children.

Data used in this analysis are from a recent survey of secondary school students ($N=128$) who study in year 7 to year 12 in public schools in metropolitan Melbourne. Male and female students from both European-Australian and Asian-Australian backgrounds participated in the survey.

II. ASSOCIATED LITERATURE

Various studies have suggested that there is a significant relationship between parental involvement and the academic achievement of their children [3]–[5]. Construct of parental involvement is multidimensional and complex. The way that parents view their role in their children's education [6] and the belief that parents have in their ability to help their children succeed at school were critical aspects in the study of parental involvement and their attitudes in children's mathematics education. Reference [7] described a lack of confidence of parents in thinking that they may not have academic competence to help their children. Moreover, it is also critical what views parents hold about children's intelligence as well as how they learn and develop their abilities.

Importantly, there are many variables within a country or culture that impact student achievement [1]. Many of these variables are interrelated so it is difficult to isolate the effect of individual factors. Reference [8] argued that attitudes are important in mathematics participation, suggesting that efforts around improving cognitive skills alone may not necessarily lead to increased mathematics participation. The implication is that if parents spend more time on improving their children's attitudes towards mathematics, then this is likely to have an impact on their achievement.

Various studies have identified a focus on parental encouragement by ethnically Asian parents. Reference [9] argued that Asian parents consistently motivate their children to achieve academic success and this encouragement may significantly contribute to the success of Asian students. Interestingly, in a comparison study of students in China and Australia, it was found that the students in China had stronger perceived parental encouragement and higher perceived parental expectations than ethnically Chinese students in Australia [10]. The authors also found that parents of Chinese

D. Weerasinghe is with the Monash university, Melbourne, Australia (e-mail: daya.weerasinghe@monash.edu).

speaking students and other non-European students in Australia have similar levels of parental encouragement but significantly higher levels of parental encouragement than English speaking students in Australia. This connects to their migrant status.

Some studies have found cultural differences in parental expectations for their children. A survey of 239 Chinese, Vietnamese, and Anglo-Celtic Australian parents of primary school children aged 6 to 14 years in South Australia found most parents had high expectations of their children's academic performance [3]. They also found that Anglo-Celtic Australian parents seem to put less emphasis on academic achievement while having more flexible expectations when compared to Chinese- or Vietnamese-Australian parents. Reference [3] also stated that it is impossible to conclude that these factors are solely responsible for ethnic group differences in academic achievement. Reference [5] randomly selected a sample of 1,500 students from Asian-American, African-American, Hispanic, and White groups with a total of 6,000 students for their analyses, in a study of direct and indirect longitudinal effects of parental involvement on student achievement using a nationally representative sample of 24,599 eighth graders from 1,052 schools in USA. They concluded that across all ethnic groups the higher the hopes and expectations of parents with respect to the educational attainment of their child, the higher the expectations of the child and greater their academic achievement. In another study based on cross-cultural comparison with 158 parents of students from two Chinese primary schools and one Anglo-Celtic primary school in Hong Kong, it has been argued that parents of different cultures have different intervention strategies and values in bringing up and educating their children [11].

III. RESEARCH METHOD

From a larger study on parental involvement in mathematics education of their children, a part of the data is presented in this paper. The study was planned primarily around surveys, using two questionnaires one each for parents and children. In addition to parental expectations for their children, this study focused on children's perspective about the expectations of their parents. Therefore, two separate instruments on mathematics education were developed with similar but different questions for parents and students. The instructions provided on the instruments informed participants that the responses should be in relation to mathematics education. Surveys were followed by semi-structured interviews for a parent and a child from purposively selected families. Only the data from the questionnaire for children are presented here.

As this study involved participants from Asian and European backgrounds, it was required to invite multicultural schools to participate in the surveys. With the permission of the Department of Education and Training (DET), four multicultural schools with Asian and European background students in metropolitan Melbourne were invited to participate. Two of those schools are select-entry schools and the other two are public schools. Only three principals from the four schools agreed to participate in the study. Hence, the information about the student questionnaire was provided to secondary school

students in one select-entry school and two public schools in the city of Melbourne. Next, the information about the parental questionnaire was given to families of those children who were interested in participating without being selective of their ethnic background or culture. The questionnaires were available online, and students and parents were able to respond whenever they wanted. For those who wanted to fill in the questionnaire on paper, a copy was provided.

A total of 213 volunteer participants from European-Australian and Asian-Australian backgrounds including 85 parents and 128 children responded to the survey. The ethnic background of each participant was recorded. In addition to Australians of Anglo-Celtic heritage, the European group included participants living in Australia who were originally from other European countries including Russia, Italy, Greece, and Turkey. The Asian group consisted of ethnically Sri Lankan, Indian, Chinese, Vietnamese, Malaysian, Singaporean, and Bangladesh participants who also live in Australia. A four-point Likert scale was used to record the responses in the questionnaires of this study (1 = Strongly agree, 2 = Agree, 3 = Disagree and 4 = Strongly disagree). No neutral option was provided thereby forcing specific choices.

Firstly, items related to each factor in the study were chosen manually and found correlations between those items. Secondly, the best fit model was identified for the factors involved using confirmatory factor analysis. Thirdly, independent samples t-tests were performed on factor scores. There were two different kinds of participants in both ethnic (European-Australian and Asian-Australian) and gender (male and female) groups. Hence, independent samples t-test was suitable for analysis. There were six different groups according to year levels from 7 to 12, where t-tests were inappropriate. Finally, to analyse year level data one-way analysis of variance (ANOVA) was used. Use of ANOVA is appropriate, as this test can find whether there are significant differences among groups and also it is able to find where these differences lie. This is facilitated by post-hoc tests in ANOVA.

IV. RESULTS

The responses to a question from children's questionnaire about parental expectations are presented in Fig. 1. More than 50% of children who responded agree that their parents expect each of them to be one of the best students in mathematics. These high expectations of parents may result in encouraging children or putting pressure on them. As a result, parental involvement in education of their children can cause positive outcomes as well as negative outcomes on both parents and children.

Fig. 2 is a comparison of responses between European-Australian and Asian-Australian groups to the same question. Fig. 2 shows higher expectations of Asian-Australian parents. Most of them want their child to be the best student or one of the best students in class. Comparatively, European-Australian parents have less expectations as the distribution implies. Next, to find out whether there is a difference in parental expectations between male and female students the following comparisons in Fig. 3 is used. In this case, there is almost no difference

between the male and female groups with regard to parental expectations. Having found these basic information about the ethnic and gender groups, the following describes further analysis involving factor analysis, t-tests, and ANOVA.

Items related to parental expectations and student performance were selected manually and for each set of items and correlations were found. Only those items with correlations greater than 0.3 were used in further analysis [12], [13]. Next,

confirmatory factor analysis (CFA) was attempted with parental expectations and student performance. Then factor loadings were examined for statistical significance. Missing values in the data were replaced with mean values and the items with negative factor loadings were reverse coded. The model was assessed and refined several times discarding items with lower factor loadings to achieve the best overall fit.

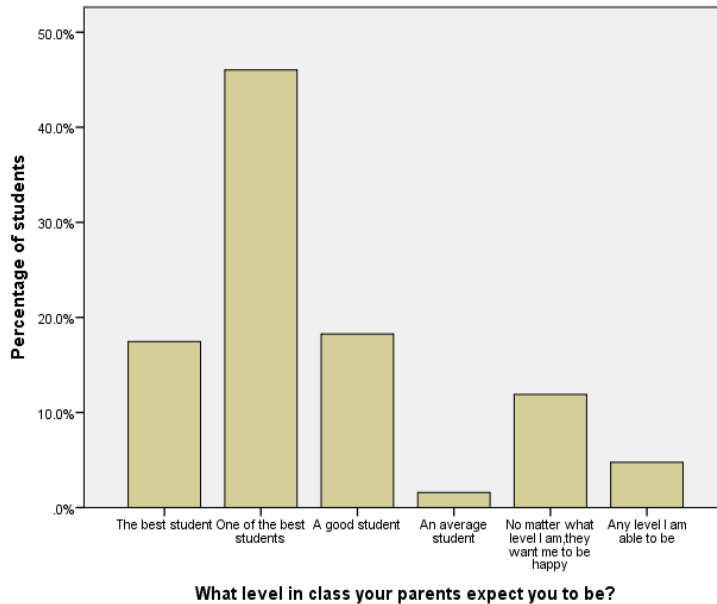


Fig. 1 Parental expectations about the mathematics level of their children

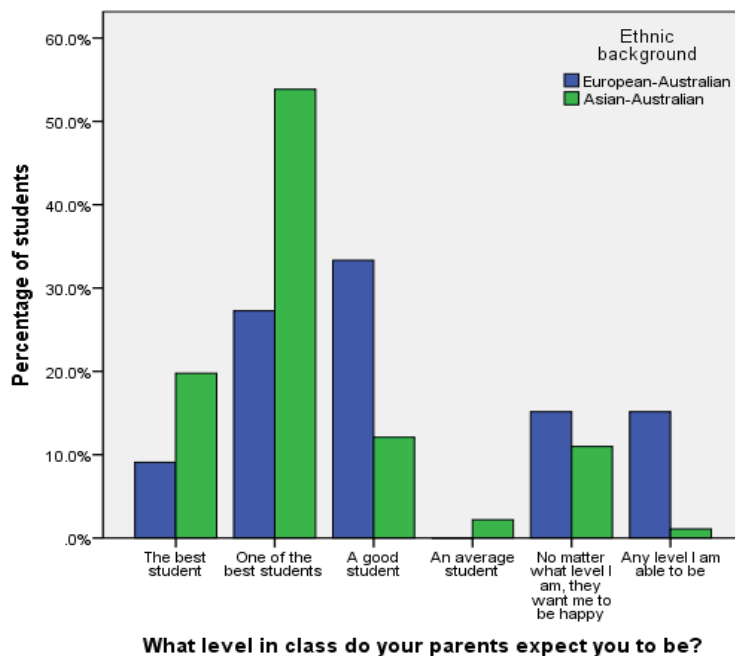


Fig. 2 Comparison of parental expectations between the two ethnic groups about the mathematics level of their children

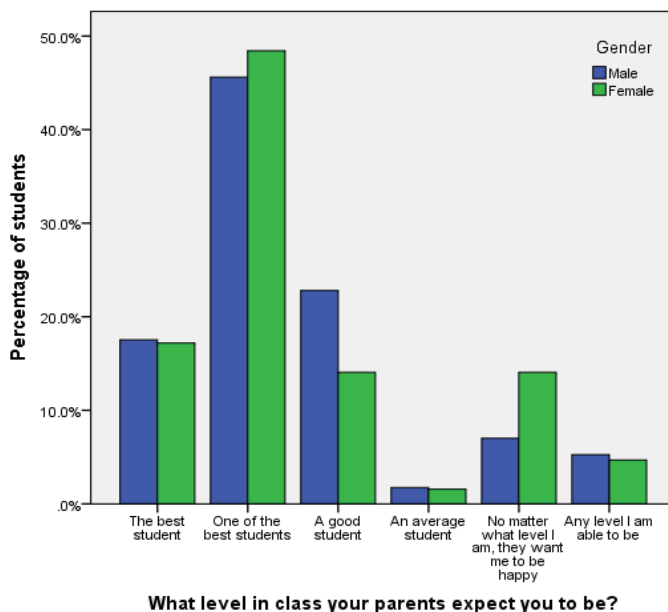


Fig. 3 Comparison of parental expectations between male and female groups about the mathematics level of their children

Chi-square value (χ^2 value), degrees of freedom (df), and probability level (p-value) were used to test and compare models in the refining process. By definition, the number that shows degrees of freedom of a model is the difference between number of observations and number of parameters. Roughly, a good fitting model may be indicated when the ratio of the χ^2 value to the df is less than two [13]. It has also been suggested that the closer the Chi-square to the degrees of freedom, the better the fit is [14]. Further, the higher the probability level associated with Chi-square, the better the fit is considered to be and the p-value should exceed 0.05 for good model fit. Decrease in both χ^2 value and df and increase in p-value resulted in a gradual approach of the best possible model.

Absolute fit indices used in this study are root mean square error of approximation (RMSEA), goodness-of-fit index (GFI), and root mean squared residual (RMR) [15]. Incremental fit index included in the study is comparative fit index (CFI). Cut-off values for model fit indices ensuring a good model were considered as RMSEA \leq 0.06 [16], GFI \geq 0.90 and 0.95 for smaller samples [17], RMR \leq 0.05 [18] or 0.08 acceptable [16], and CFI \geq 0.95 [16]. Out of the model fit indices discussed, RMSEA and CFI are considered to be the most insensitive to the sample size [15], [19].

Fig. 4 shows the CFA model for the parental expectations and student performance. In addition, factor scores (FS) were calculated so that those values could be involved in further tests such as t-tests and ANOVA.

With parental expectations and student performance, the resulting CFA model ($n = 128$, χ^2 value = 51.042, $df = 41$, p -value = 0.135, RMSEA = 0.044, GFI = 0.930, RMR = 0.036, and CFI = 0.976), factor loadings (standardised regression weights), and covariance value between the two factors are shown in Fig. 4.

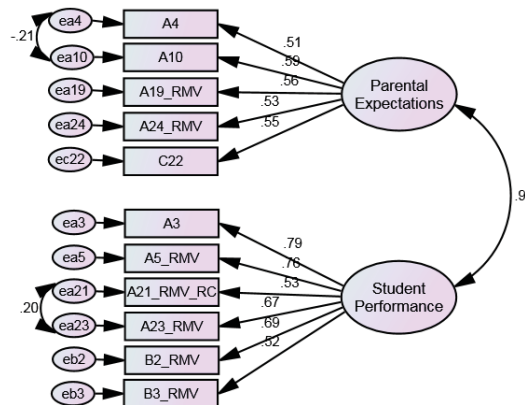


Fig. 4 CFA model for parental expectations and student performance

Independent-samples t-tests were carried out to compare means between both ethnic background and gender of students and also to find out whether there were significant differences between groups. For both ethnic background and gender variables there were only two different groups of participants (i.e., European-Australian and Asian-Australian for ethnic background and Male and Female for gender). As independent-samples t-tests are restricted to only two groups, to analyse year level data from year 7 to year 12 one-way ANOVA was used.

The following are the results of independent-samples t-tests that were conducted to compare factor scores of parental expectations and student performance between European-Australian ($n = 33$) and Asian-Australian ($n = 91$) children. Test output included mean and standard deviation of each group. To find significant differences between groups, the other available outputs of independent-samples t-test were observed. One such output includes the results of Levene's test for

equality of variances. This test checks whether variance of the scores for the two groups (European-Australian and Asian-Australian) is the same. If the significance level of Lavene's test is greater than 0.05 it is possible to assume equal variances between groups [12], [20]. If the significance level (p -value) is less than or equal to 0.05, there is a significant difference in the mean scores for each of the two groups [12].

In addition to statistical significance, effect size statistic could also be used to find the strength of association between variables. Effect size statistic known as eta-squared (η^2) was calculated for each factor using output data from independent-samples t-test to provide an indication of the magnitude of the differences between the two ethnic groups. Effect size can range from 0 to 1 and it represents the variation in the dependent variable that can be explained by the variation in the independent variable [12]. In this case, dependent variable is the factor and the independent variable is the ethnic group.

The guidelines for effect size proposed to interpret η^2 values obtained in independent-samples t-tests were as follows with no strict cut-off to delineate small, medium, or large effects [21].

Small effect	= 0.0099
Medium effect	= 0.0588
Large effect	= 0.1379

Results that compare the two ethnic groups are shown in Table I.

TABLE I
COMPARISON OF ETHNIC GROUP DIFFERENCES IN PARENTAL EXPECTATIONS AND STUDENT PERFORMANCE

	European-Australian		Asian-Australian		$t(122)$	p	η^2
	M	SD	M	SD			
Parental expectations	2.07	.53	1.96	.48	1.04	.30	0.009
Student performance	2.37	.66	2.19	.63	1.45	.15	0.017

TABLE II
COMPARISON OF GENDER DIFFERENCES IN PARENTAL EXPECTATIONS AND STUDENT PERFORMANCE

	Male		Female		$t(122)$	p	η^2
	M	SD	M	SD			
Parental expectations	2.01	.47	1.97	.51	.53	.60	0.002
Student performance	2.25	.62	2.23	.66	.16	.87	0.0002

The results shown in Table I do not indicate a significant difference in scores between European-Australian and Asian-Australian parents with regard to parental expectations for their children. Further, there was no significant difference in student performance between the two groups. Even though statistical significance in Table I showed that there was no significant difference in parental expectations or student performance between the two cultures, the effect size statistic showed a small effect for both factors.

Parental expectations and student performance were subjected to another independent samples t-test to find male and female group differences. Significance level of Lavene's test for equality of variances for each of the three factors was greater than 0.05. Hence, the assumption of homogeneity of variance

has not been violated. The relevant values are shown in Table II.

When the p -values are greater than 0.05, there is no significant difference in the mean scores of the two groups. According to the results shown in Table II, there was no significant difference in parental expectations or student performance when comparing male and female students. Further, the effect size statistics confirmed that there was no effect in parental expectations or student performance when comparing male and female students.

As the variable year level has six groups from year 7 to year 12, one-way between-groups ANOVA with post-hoc tests were considered as appropriate. While one-way ANOVA can find out whether there are significant differences in the mean scores on each factor (dependent variable in this case) across year levels, post-hoc tests can find out where these differences lie.

One of the outputs from the process of ANOVA provided Levene's test for homogeneity of variances for each factor. Significance values obtained for Levene's test were greater than 0.05 showing the factors of interest had not violated the assumption of homogeneity of variances. This means that the variance in scores is the same for each of the six year levels, not requiring further robust tests to continue with ANOVA. Further, effect size statistic eta squared was calculated using the ratio between sum of squares between groups and total sum of squares. Results are presented in Table III.

TABLE III
ONE-WAY ANOVA FOR PARENTAL EXPECTATIONS AMONG YEAR LEVELS

		$Sum\ of\ Squares$	$Mean\ Square$	$F(5, 118)$	p	η^2
Parental expectations	Between Groups	3.702	.740	3.366	.007	0.125
	Within Groups	25.949	.220			
Student performance	Between Groups	5.705	1.141	2.989	.014	0.112
	Within Groups	45.044	.382			

If the p -value is less than or equal to 0.05 there is a significant difference somewhere among the mean scores of the relevant factor and year levels. Hence, the results have showed a significant difference in both parental expectations and student performance with respect to year levels. According to guidelines [21] used, the effect size statistics showed nearly large effect in both parental expectations and student performance across year levels. To find where those significance occur multiple comparisons in post-hoc tests were used.

Both factors showed significantly different results at the 0.05 level. Subsequently, parental expectations between year 7 ($M = 1.52$, $SD = 0.34$) and year 11 ($M = 2.06$, $SD = 0.51$) groups and year 7 and year 12 ($M = 2.19$, $SD = 0.52$) groups were significantly different. Student performance between year 7 ($M = 2.14$, $SD = 0.49$) and year 12 ($M = 3.03$, $SD = 0.79$) groups were also significantly different.

V. CONCLUSION

For the group of students in this study there was no significant difference in parental expectations and student performance with respect to their ethnic background or gender. However, there were differences in parental expectations and student performance at different year levels. To study these differences a larger sample of students is required. Also, it would be more meaningful to divide secondary school students as lower and upper secondary school students to find any differences as the age differences could be an issue in data analysis.

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